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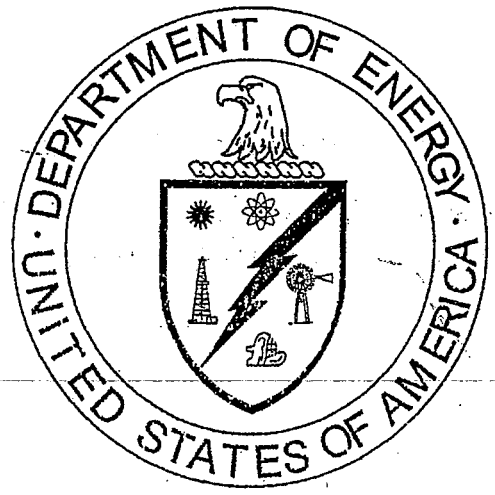
REPORT OF FINDINGS

Special Study for Metals and Radiological Parameters in Groundwater

FOR THE
PORTSMOUTH GASEOUS DIFFUSION PLANT,
PIKETON, OHIO



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DOE/OR/11-3029&D3

REPORT OF FINDINGS
SPECIAL STUDY
for
METALS AND RADIOLOGICAL PARAMETERS
in
GROUNDWATER

at the
Portsmouth Gaseous Diffusion Plant
Piketon, Ohio

July 2000

Prepared by
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Prepared for the U.S. Department of Energy
Office of Environmental Restoration and Waste Management

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managing the
Environmental Management Activities at the
Portsmouth Gaseous Diffusion Plant
P. O. Box 900
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under contract DE-AC05-84OR21400
for the
U.S. DEPARTMENT OF ENERGY

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ACRONYMS AND ABBREVIATIONS

µg/L	microgram per liter
AOC	Area of Concern
ARARs	Applicable or Relevant and Appropriate Requirements
CAS	Cleanup Alternatives Study
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
DOE	U.S. Department of Energy
ELCR	Excess Lifetime Cancer Risk
HI	Hazard Index
IGWMP	Integrated Groundwater Monitoring Plan
MCL	Maximum Contaminant Level
NTU	Nephelometric Turbidity Unit
Ohio EPA	Ohio Environmental Protection Agency
pCi	picocuries
PORTS	Portsmouth Gaseous Diffusion Plant
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

Based on initial data obtained from the use of low-flow sampling techniques at the Portsmouth Gaseous Diffusion Plant (PORTS), the United States Department of Energy (DOE) and the Ohio Environmental Protection Agency (Ohio EPA) developed a revised approach for evaluating potential metals and radiological contamination in ten areas of concern (AOCs). This approach included the completion of a special study consisting of the re-sampling of selected wells in the ten AOCs. The objective of this special study is to confirm or refute earlier determinations regarding metals and/or radiological contamination by determining if the elevated metals concentrations observed during the Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFIs) were due to sample turbidity. This determination involved a comparison of turbidity values and associated metals concentrations obtained from analysis of the RFI samples collected with a bailer to those obtained using low-flow sampling methods. Special sampling for this report was performed according to specifications provided in the Integrated Groundwater Monitoring Plan (IGWMP) for the Portsmouth Gaseous Diffusion Plant [IGWMP, (DOE 1998c)].

Selection of the ten metal AOCs, in December 1996, was based on metals results from unfiltered groundwater sampled with bailers during the RFIs. AOCs were selected based on conditions related to one or more of the following criteria: high metal concentrations in one or more wells as determined from historical data; high frequency of wells with unfiltered metal detections above background levels or MCLs; a potential source such as a landfill; and/or a known groundwater volatile organic compound (VOC) plume.

The wells selected for sampling during this special study include both Gallia and Berea wells. Low-flow bladder pumps were used to extract samples to minimize turbidity. Samples were analyzed for turbidity as well as metals and radiological parameters. Two rounds of low-flow sampling were completed at each AOC from August 1997 through March 1999. Low-flow sampling results from wells sampled in the PORTS groundwater monitoring program during the period from 1998 through the first quarter of 1999 were also evaluated.

It is apparent from a review of the data that low-flow sampling methods reduce turbidity of samples as compared to samples collected with a bailer. Decreases in specific metal concentrations, gross alpha, and gross beta activities also correspond with decreases in turbidity.

Three AOCs have no metal concerns and require no further monitoring for non-radiological metals. These three AOCS are:

- Quadrant II Groundwater Investigative Area
- X-740 Waste Oil Handling Facility Area (Quadrant III)
- X-344/X-630 Area (Quadrant IV)

Additional monitoring for metals is required at seven of the ten AOCs:

- Quadrant I Groundwater Investigative Area
- X-120/X-749/Peter Kiewit Landfill Area (Quadrant I)
- X-701B Holding Pond Area (Quadrant II)

- X-744G Bulk Storage Building (Quadrant II)
- X-633 Pump House and Cooling Towers Area (Quadrant II)
- X-533 Switchyard and Associated Buildings (Quadrant IV)
- X-734 Landfills Area (Quadrant IV)

If the groundwater monitoring should demonstrate an increase of metals at these seven units, then additional remedial evaluation will be performed.

Monitoring associated with the Peter Kiewit Landfill (part of the X-120/X-749/PK AOC) and the X-734 Landfills Area includes metals analyses. Cobalt was detected during two rounds of sampling from wells screened within the drainage ditch alluvium composed of sediment and reworked Sunbury and Berea deposits. Naturally occurring cobalt has been identified in the Berea formation, based on background sampling results. These results were collected from wells located adjacent to the landfills, so a release cannot be ruled out. Other metal concentrations, radiological activities and associated distribution patterns do not indicate metals or radiological contamination problems within these AOCs. Monitoring, including analysis for cobalt, will continue as prescribed in the IGWMP for these landfills.

Injection of oxidants associated with demonstration projects to evaluate technologies applicable in the remediation of VOCs, resulted in residual oxidant concentrations (containing manganese) that should be monitored at the X-701B and Quadrant I Groundwater Investigative Areas. Data gathered from this monitoring will be useful in understanding dissipation rates for oxidants in the event of future injection applications.

One AOC, X-701B Holding Pond Area in (Quadrant II), has two wells, X701-BW2G and X701-09G with an array of metals above PRGs located centrally within the VOC plume. These wells are separated by wells with lower metals concentrations (from non-detect to less than PRGs). This discontinuity in metals concentrations indicates that there is not a widespread metals problem in this AOC. However, additional monitoring for selected metals is warranted.

The three remaining AOCs evaluated during this special study have detections of metals above PRGs that were detected in two or more adjacent wells during both sampling rounds or during both rounds of sampling in one well in the vicinity of a plausible source. These three AOCs and associated potential contaminants include:

Area of Concern	Potential Contaminants
X-744G Bulk Storage Building	Cadmium, Nickel
X-533 Switchyard and Associated Buildings	Cadmium, Cobalt, Nickel
X-633 Pump House and Cooling Tower Area	Chromium

Cadmium and nickel were detected above PRGs during both rounds of sampling in three wells south and west of the X-744G Bulk Storage Building (Quadrant II). These wells are bounded by wells where cadmium and nickel concentrations were either below detection limits or below background levels. Nickel concentrations in this area do not result in HI values greater than one; however, cadmium HI values are greater than one. A review of soil data in this area did not indicate contaminant sources for these two metals. It should also be noted that the low-flow sampling conducted during this study produced turbid

samples at most of the wells in this area. Continued monitoring of this area during the Quadrant II CMI is warranted.

Cadmium, cobalt and nickel were detected above PRGs in groundwater in the vicinity of the X-533 Switchyard and Associated Buildings (Quadrant IV). Cadmium, cobalt and nickel were detected during both rounds of sampling at X533-03G and F-03G north of the X-533 Switchyard and north of the transformer cleaning pad, respectively. A review of soil data in this area does not indicate significant concentrations of cadmium or cobalt, although nickel is detected slightly above background throughout the area. Although widespread occurrence of these metals in groundwater at this AOC is not apparent, continued monitoring may be warranted.

Chromium was detected above the PRG in groundwater in the vicinity of the X-633 Pump House and Cooling Towers (Quadrant II). Chromium was detected during both rounds of sampling at X633-07G west of the X-633-2C cooling tower basin. A review of soil data in this area does not indicate significant concentrations of chromium in the area. Although widespread occurrence of chromium in groundwater at this AOC is not apparent, continued monitoring may be warranted.

The Quadrant II Groundwater Investigative Area and the X-701B Holding Pond were the only AOCs with technetium activities that exceeded the PRG. These areas are controlled by groundwater extraction systems and are being remediated concurrently with the VOC plumes. Treatment facility effluent monitoring indicates that any radiological constituents contained in influent are being removed.

An evaluation of wells with repeated detections of gross alpha or gross beta greater than background indicates correspondingly elevated levels of uranium or technetium, respectively. Turbidity appears to have been responsible for most of the elevated gross alpha and gross beta activities detected in RFI samples.

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1. INTRODUCTION

The Portsmouth Gaseous Diffusion Plant (PORTS) is located near Piketon, Ohio, in the south-central portion of the state. The principal process at the PORTS facility is the separation of uranium isotopes through gaseous diffusion. The active or industrialized portion of the plant site encompasses approximately 1,000 acres of the 3,714-acre United States Department of Energy (DOE) reservation. Environmental conditions at PORTS have been assessed, in part, by a long-term groundwater monitoring program as well as individual groundwater sampling investigations. Groundwater flow beneath most of PORTS occurs in two distinct hydrogeologic units: an upper water-bearing unit in the unconsolidated material (Gallia) and a lower water-bearing unit in the Berea sandstone (Berea). On the basis of sample data from historical groundwater monitoring of these hydrogeologic units at PORTS, ten metals Areas of Concern (AOCs) were selected in December 1996 (DOE 1998c). The ten AOCs are listed below and their locations at PORTS are shown in Figure 1.1.

Quadrant I

- Quadrant I Groundwater Investigative Area (including the X-747F Material Storage Yard)
- X-120/X-749/PK Landfill Area

Quadrant II

- Quadrant II Groundwater Investigative Area
- X-701B Holding Pond
- X-744G Bulk Storage Building
- X-633 Pump House and Cooling Towers

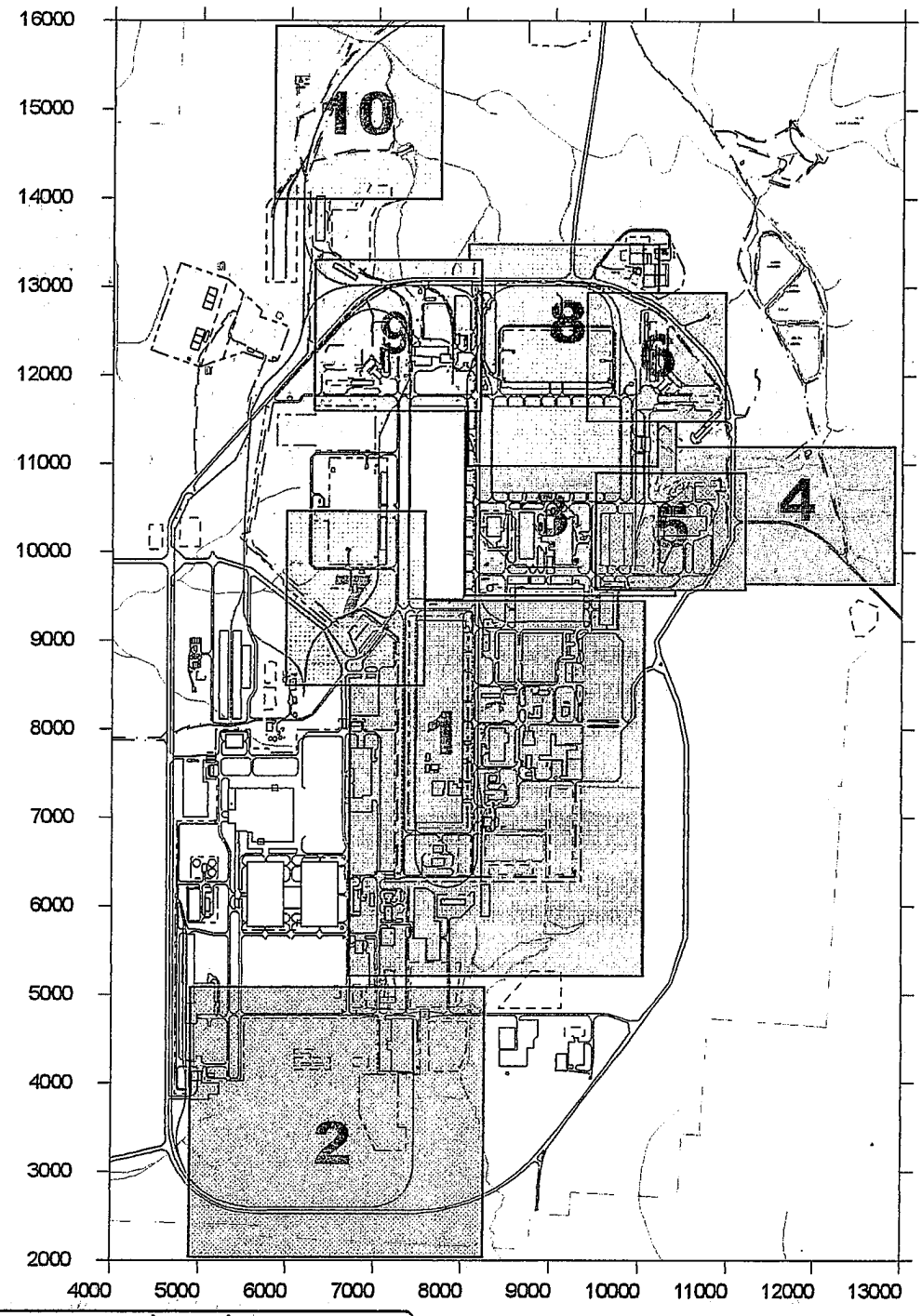
Quadrant III

- X-740 Waste Oil Handling Facility

Quadrant IV

- X-533 Switchyard and Associated Buildings
- X-344/X-630 Area
- X-734 Landfills

These AOCs were primarily identified on the basis of historical unfiltered groundwater sample data. Most of these groundwater samples were collected using bailers, which are more likely to yield turbid samples that may influence the concentrations of detected metals or radiological parameters. High sample turbidity is believed to be responsible for the elevated RFI results for metals, gross alpha, and gross beta.



Legend

1 Quadrant I Groundwater Investigative Area
2 X-120 / X-749 / PK Landfill Area
3 Quadrant II Groundwater Investigative Area
4 X-701B Holding Pond Area
5 X-744G Bulk Storage Building Area
6 X-633 Pump House and Cooling Towers Area
7 X-740 Waste Oil Handling Facility Area
8 X-533 Switchyard and Associated Buildings Area
9 X-344 / X-630 Area
10 X-734 Landills Area

Fig. 1.1

Special sampling for metals and radiological parameters areas of concern

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On the basis of initial data obtained from the use of low-flow, low-volume sampling techniques at PORTS, DOE and the Ohio Environmental Protection Agency (Ohio EPA) developed a revised approach for evaluating potential metals and radiological contamination at the AOCs. This approach included the completion of a special study consisting of the re-sampling of wells in the ten AOCs where historically high concentrations of metals and elevated radiological activity values have been detected. The objective of the special study is to confirm or refute earlier determinations regarding metals and/or radiological contamination at the AOCs by determining if the elevated metals concentrations observed during the RFI were due to sample turbidity.

Procedures for the special study and a list of wells to be re-sampled were provided in the Integrated Groundwater Monitoring Plan for the Portsmouth Gaseous Diffusion Plant [IGWMP, (DOE 1998c)]. The wells selected for sampling during this special study include both Gallia and Berea wells that are generally a subset of the wells sampled for long-term monitoring of volatile organic compounds (VOCs) and other constituents. Wells were selected to correspond with, or to be in the vicinity of, wells which have exhibited high metal concentrations or high gross alpha and gross beta activities (DOE 1998c). Groundwater samples were collected twice from each well. Well sampling was conducted from August 1997 through March 1999. Although only a few Berea wells were included in this study, the effect of turbidity on metals concentrations in Berea groundwater was more fully evaluated in the Berea Metals Study Report (DOE 1998a). The results of that study indicate that adequate well development which reduces turbidity, results in lower metal concentrations in Berea groundwater. Additional well development has not been as successful in reducing turbidities in wells screened in the unconsolidated Gallia.

In order to obtain representative samples, bladder or peristaltic pumps were used to extract the samples at a low-flow rate and to minimize turbidity. Samples were analyzed for turbidity, metals and radiological parameters listed in Table 1.1:

Table 1.1 List of metals and radiological parameters

Metals		Radiological Parameters
Antimony*	Lead	Gross Alpha
Arsenic	Manganese	Gross Beta
Barium*	Mercury*	Technetium
Beryllium	Nickel	Uranium
Cadmium	Silver	
Chromium	Thallium	
Cobalt	Vanadium	

* At the request of Ohio EPA, barium and mercury were added to the analyte list for the X-633 wells and mercury was added to the analyte list for well X701-46G. Also, antimony was added to the analyte list for the second round of sampling of the X749/X120 wells.

The first round of sampling results was submitted to Ohio EPA on November 4, 1998 (DOE 1998b) in accordance with the agreement reached in a meeting between the Ohio EPA and DOE on July 28, 1998. This report fulfills the requirements of that agreement by presenting the complete set of results for the metals special study including results for the first and second rounds of sampling.

In addition to the samples collected specifically for this study, metal and/or radiological parameter results have been obtained from other wells or sampling events within some of the metals AOCs. Beginning the first quarter of 1998, all samples from PORTS to be analyzed for inorganic constituents according to the IGWMP have been collected using low-flow sampling techniques (dedicated bladder pump or peristaltic pump). These results through the first quarter of 1999 are included in the evaluation of each AOC.

2. METHODOLOGY

This section provides references for procedures used to collect and analyze groundwater samples from the metals special study. This section also provides an explanation of the screening process used to evaluate metals concentrations and radionuclide activity within the AOCs.

2.1 SAMPLING AND ANALYSIS

Wells selected for sampling during this special study are listed in the IGWMP. Two wells, X701-28G and X701-46G, are included on the list for two AOCs (Quadrant II Investigative Area and the X-701B Holding Pond) in the IGWMP. Based on the selected AOC boundaries for this report, these two wells have been included in the discussion for the Quadrant II Investigative Area; analytical results for these wells are summarized on associated tables and figures.

Well X701-01G is included with the X-701B Holding Pond AOC in the IGWMP. However, based on metals results, the upgradient location at X-701B and the proximity to the X-744G Bulk Storage Building, this well has been included in the discussion of the X-744G Bulk Storage Building AOC.

In order to obtain representative samples, groundwater sampling during this study was performed using low-flow sampling techniques to minimize turbidity. Turbidity measurements are presented in Tables A-1 through A-10 in Appendix A for each groundwater sample collected for this study. A comparison of turbidities and analyte concentrations from bailed and low-flow samples is included in Section 3.

Groundwater sample collection and handling were performed according to procedures outlined in the IGWMP. All wells listed in the IGWMP were sampled for all required parameters with the exception of X734-16G, X734-20G and X734-05B, which produced insufficient sample volumes, and PK-02G, PK-06G and X749-12G which have been plugged and abandoned.

Analytical methods used during this study are summarized below. During this study, metals were analyzed by SW-846 Method 6010 with the exception of lead and mercury which were analyzed according to SW-846 Method 7421 and SW-846 Method 7470, respectively. Because analytical results from some of the wells were obtained from the natural attenuation sampling conducted in 1997 and 1998, different analytical methods were used for arsenic and lead. Analytes and associated analytical methods are listed in Table 2.1.

Table 2.1. Analytical laboratory methods used for each analyte

Analyte	Most Commonly Used Method	Other Methods Reported in this Study
Antimony	SW846 6010	
Arsenic	SW846 6010	SW846 7060
Barium	SW846 6010	
Beryllium	SW846 6010	
Cadmium	SW846 6010	
Chromium	SW846 6010	
Cobalt	SW846 6010	
Lead	SW846 7421	SW846 6010
Manganese	SW846 6010	
Mercury	SW846 7470	
Nickel	SW846 6010	
Silver	SW846 6010	
Thallium	SW846 6010	
Vanadium	SW846 6010	
Gross Alpha	PORTS XP4-TS-RL7230	PORTS TSD553-230
Gross Beta	PORTS XP4-TS-RL7230	PORTS TSD553-230
Technetium	PORTS XP4-TS-RL7330	PORTS TSD553-330
Uranium	PORTS XP4-TS-ST7900	PORTS TSD552-150

2.2 SAMPLE SCREENING

Metal concentrations and radionuclide activities were compared to preliminary remediation goals (PRGs) which have been defined in the approved Cleanup Alternatives Study/Corrective Measures Study (CAS/CMS) Reports for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE 1998d). PRGs used for evaluating analyte concentrations at PORTS consist of values compiled from Applicable or Relevant and Appropriate Requirements (ARARs) established for regulating groundwater at a Resource Conservation and Recovery Act (RCRA) Facility (primarily maximum contaminant levels [MCLs]), PORTS site-specific background values and risk-based values (hazard index [HI] = 1 or excess lifetime cancer risk [ELCR] = 10^{-6} future industrial worker). PRGs were determined using the following steps:

1. If both the MCL and the background value exist for an analyte, the greater of the MCL and the background value is selected as the PRG.

2. If an MCL does not exist for an analyte, the greater of the background value and the risk-based value is selected as the PRG.

3. If the neither the MCL nor the background value exists for an analyte, a risk-based value is selected as the PRG.

PRGs selected for this study using these steps are consistent with the PRG selection criteria utilized in the CAS/CMS Reports (DOE 1998d) with the exception of the following:

- The PRG for silver has been increased from 50 micrograms per liter (µg/L) to 509 µg/L. The PRG value of 50 µg/L included in the CAS/CMS Reports was a former MCL; however, the current list of MCLs does not provide a primary MCL for silver (Ohio EPA 1994). Because a current MCL does not exist for silver, the greater of the background value and the risk-based value was chosen as the PRG. Therefore, risk-based value of 509 µg/L, as defined for the CAS/CMS (DOE 1998d), was selected as the PRG for silver.

- MCLs and PRGs are not established for gross alpha and gross beta. Instead, PRGs are developed for radiological contaminants contributing to gross alpha and gross beta activities such as uranium and technetium, respectively. High turbidities are believed to contribute historically to elevated gross alpha and gross beta activities in samples without corresponding high uranium or technetium levels, respectively. Background levels established for gross alpha and gross beta were used as screening levels for this evaluation.

Because analyte background values differ for the Gallia and Berea aquifers, PRGs were developed for both Gallia and Berea wells.

3. TURBIDITY ANALYSIS AND COMPARISON

Turbidity in samples can bias metals concentrations because naturally occurring metals in the suspended solids are liberated upon acidification during sample preparation. The relationship between turbidity and metals/radiological values was examined by comparing RFI groundwater sample data collected using bailers, and metals special study data collected using low-flow sampling methods. In comparing the turbidity results obtained during the RFI versus those obtained from low-flow sampling events, the first round of low-flow sampling showed a reduction in 94.3% of the wells and the second round showed a reduction in 96.5% of the wells. The results are shown in Table 3.1.

The results for the constituent-based turbidity comparison are presented in Table 3.2. For the purpose of this evaluation, the only well locations considered were those that had turbidity and constituent analyses performed in both sample sets. Turbidity values decreased in Round 1 for 94.5% of the wells and in Round 2 for 99.8% of the wells.

The results of the comparison of metals and radiological parameters derived from bailed samples collected during the RFI and low-flow sampling Rounds 1 and 2 are presented in Table 3.3. In general, metals concentrations and radiological activities decreased in both rounds of low-flow sampling for 82% of the samples. Antimony, beryllium, thallium, and uranium yielded minimal detections in corresponding RFI and special study wells; therefore, no conclusions related to these parameters can be drawn. Gross alpha activity and arsenic, barium, cadmium, chromium, cobalt, nickel, lead, and vanadium concentrations decreased in

Table 3.1. RFI and metals special study turbidity results (p. 1 of 2)

	RFI		Special Study Round 1		Special Study Round 2	
Well ID	Sample Date	Turbidity (NTUs)	Sample Date	Turbidity (NTUs)	Sample Date	Turbidity (NTUs)
F-03G	4/4/94	100.28	8/28/98	31	3/23/99	6
LBC-PZ03	11/4/93	>200	2/12/98	2	8/6/98	2
LBC-PZ06	11/5/93	>200	2/12/98	7	8/6/98	4
PRCL-01G	1/12/94	25	11/4/98	13	3/23/98	3
X120-03G	11/17/93	>200	10/14/97	48	9/18/98	8
X120-05G	1/31/94	>200	10/2/97	5	9/21/98	8
X120-08G	11/20/93	>200	1/28/98	10	9/3/98	2
X120-10G	11/20/93	>200	10/2/97	8	8/18/98	6
X231A-04G	11/19/93	>200	10/3/97	55	8/31/98	53
X231B-11G	11/21/93	187.1	9/30/97	5	8/17/98	2
X231B-19G	11/20/93	>200	9/27/97	1	9/1/98	1
X342C-01G	4/13/94	>200	8/26/98	2	3/29/99	1
X533-02G	4/14/94	>200	8/27/98	28	3/23/99	5
X630-01G	4/8/94	43.53	8/21/98	3	3/25/99	1
X630-02G	6/3/94	106.15	8/21/98	2	3/26/99	1
X630-03G	6/3/94	>200	8/21/98	6	3/26/99	1
X633-04G	11/23/93	22	9/28/98	28	3/26/99	10
X633-07G	12/2/93	>200	8/27/98	18	3/29/99	8
X633-10G	12/6/93	>200	9/2/98	33	3/26/99	25
X700-01G	12/2/93	71	2/13/98	6	9/9/98	1
X700-02G	12/3/93	>200	2/23/98	80	9/10/98	25
X701-01G	11/10/93	>200	2/27/98	51	9/15/98	36
X701-04G	11/10/93	>200	2/27/98	24	9/17/98	16
X701-09G	11/10/93	66.3	3/2/98	158	8/5/98	103
X701-22G	11/1/93	>200	3/17/98	16	9/17/98	5
X701-23G	11/15/93	60.2	3/13/98	1	8/5/98	1
X701-27G	11/10/93	54.1	2/12/98	3	9/8/98	1
X701-28G	12/1/93	>200	2/12/98	11	9/8/98	6
X701-40G	11/11/93	19.1	3/27/98	13	9/18/98	3
X701-45G	11/16/93	>200	2/18/98	13	9/8/98	2
X701-46G	11/16/93	27.9	2/17/98	8	9/8/98	4
X701-68G	12/2/93	>200	2/11/98	3	8/26/98	4
X701-69G	12/2/93	>200	3/11/98	8	8/26/98	35

Table 3.1: RFI and metals special study turbidity results (p. 2 of 2)

	RFI		Special Study Round 1		Special Study Round 2	
Well ID	Sample Date	Turbidity (NTUs)	Sample Date	Turbidity (NTUs)	Sample Date	Turbidity (NTUs)
X701-70G	1/13/94	>200	3/18/98	2	8/26/98	3
X705-01G	11/30/93	71.9	2/13/98	16	9/10/98	19
X705-02G	11/30/93	>200	2/19/98	7	9/10/98	1
X705-03G	12/1/93	12.4	2/23/98	19	9/10/98	31
X705-04G	12/9/93	>200	2/24/98	8	9/10/98	2
X705-06G	1/11/94	>200	2/13/98	3	9/10/98	2
X705-07G	12/1/93	>200	2/24/98	31	9/11/98	13
X705-08G	12/7/93	>200	2/13/98	7	9/11/98	18
X705-10B	12/14/93	>200	2/13/98	19	2/11/98	6
X720-01G	11/23/93	95.2	2/19/98	3	9/9/98	2
X720-07G	12/27/93	>200	2/18/98	23	9/9/98	22
X734-01G	6/6/94	>200	1/5/98	50	8/12/98	33
X734-05B	4/8/94	>200	1/7/98	**400**	8/14/98	20
X734-18G	6/2/94	>200	1/5/98	63	8/13/98	50
X734-20G	6/13/94	>200	1/6/98	**221**	8/13/98	3
X744-01G	11/16/93	>200	7/8/98	**297**	3/18/99	121
X744-02G	11/16/93	>200	7/8/98	102	3/18/99	20
X744-03G	12/28/93	>200	7/8/98	**312**	3/19/99	58
X747F-01G	12/7/93	17	8/20/98	1	3/19/99	1
X747F-02G	12/9/93	>200	8/20/98	1	3/19/99	1
X747F-03G	1/12/94	>200	8/20/98	4	3/19/99	1
X749-41G	12/11/93	>200	10/2/97	17	9/21/98	20
X749-42G	12/11/93	>200	10/2/97	12	9/18/98	1
X760-07G	12/17/93	23.2	9/30/97	6	8/31/98	1
Percent reduced from RFI				**94.5%**		**99.8%**

Bolded values mean no comparison is possible because RFI turbidity readings are only valid below 200 NTU.

NTU = Nephelometric turbidity unit

Table 3.2. Comparison of turbidity values between RFI bailed samples and special study low-flow samples rounds 1 and 2

Metal and Radiological Parameters	Wells Sampled In Both RFI and Special Study	Round 1 Wells Where Turbidity Decreased From RFI	Percentage of Round 1 Wells With Decreased Turbidity	Round 2 Wells Where Turbidity Decreased From RFI	Percentage of Round 2 Wells With Decreased Turbidity
Gross Alpha	27	26	93.8%	27	100.0%
Antimony	33	31	93.9%	33	100.0%
Arsenic	29	27	93.1%	29	100.0%
Barium	32	30	93.8%	31	96.9%
Beryllium	33	31	93.9%	33	100.0%
Cadmium	33	31	93.9%	33	100.0%
Chromium	33	31	93.9%	33	100.0%
Cobalt	33	31	93.9%	33	100.0%
Gross Beta	32	30	93.8%	32	100.0%
Mercury	3	3	100.0%	3	100.0%
Nickel	33	32	97.0%	33	100.0%
Lead	23	22	95.7%	23	100.0%
Silver	33	31	93.9%	33	100.0%
Thallium	33	32	97.0%	33	100.0%
Technetium	31	29	93.5%	31	100.0%
Uranium	31	29	93.5%	31	100.0%
Vanadium	33	31	93.9%	33	100.0%
Totals	**505**	477	**94.5%**	**504**	**99.8%**

Table 3.3. Comparison of analyte concentrations (metals) or activities (radiological parameters) between RFI bailed samples and special study low-flow samples rounds 1 and 2

Metal and Radiological Parameters	Round 1 Wells With Change In Concentration From RFI	Round 1 Wells Where Concentrations Decreased From RFI	Percent of Round 1 Wells with Decreased Concentration	Round 2 Wells With Change In Concentration From RFI	Round 2 Wells Where Concentrations Decreased From RFI	Percent of Round 2 Wells with Decreased Concentration
Gross Alpha	8	8	100.0%	10	10	100.0%
Antimony	1	1	100.0%	1	1	100.0%
Arsenic	22	22	100.0%	15	15	100.0%
Barium	24	22	91.7%	27	25	92.6%
Beryllium	2	1	50.0%	2	2	100.0%
Cadmium	6	6	100.0%	6	6	100.0%
Chromium	29	25	86.2%	29	24	82.8%
Cobalt	20	19	95.0%	16	16	100.0%
Gross Beta	15	10	66.7%	18	13	72.2%
Mercury	0	0	0.0%	0	0	0.0%
Nickel	21	21	100.0%	23	21	91.3%
Lead	17	16	94.1%	16	16	100.0%
Silver	13	0	0.0%	15	0	0.0%
Thallium	3	0	0.0%	4	0	0.0%
Technetium	11	4	36.4%	7	3	42.9%
Uranium	2	0	0.0%	3	0	0.0%
Vanadium	26	26	100.0%	26	26	100.0%
Total	**220**	**181**	**82.3%**	**218**	**178**	**81.7%**

greater than 83% of the samples in both rounds of low-flow sampling. Gross beta activity decreased in greater than 67% of the wells examined. Silver concentrations did not decrease in any of the wells examined. Technetium activity decreased in 36% of the Round 1 wells and 43% of the Round 2 wells examined.

In general, low-flow sampling methods resulted in decreases in turbidity and associated decreases in metals concentrations, and gross alpha and gross beta activities.

4. SAMPLING RESULTS

The following sections discuss the results for metals and radiological parameters at each AOC. Analytical results for wells in each AOC are included in Tables A-1 through A-10 in Appendix A. These tables summarize sampling results and identify values greater than MCLs, background values and PRGs for metals and radionuclides. Maps for each AOC, that identify sample locations and analytical values greater than PRGs, are presented in Figures 4.1 through 4.10. The figures present first and second round metals special study sampling results in red, and additional low-flow sampling results in blue at each well location where constituents were detected above PRGs; results are provided for constituents detected above the PRG during one or more of the sampling events.

Additional low-flow sampling results collected from the metals special study wells and other nearby wells during 1998 and first quarter 1999 are presented in Appendix B. Values for analytical results from the additional data that exceed PRGs are also presented in Figures 4.1 through 4.10.

Three metals (antimony, cobalt, and thallium) had numerous isolated detections that slightly exceeded background based PRGs in many of the AOCs. Specific sources or use of these metals at PORTS have not been identified.

Antimony - Antimony is often alloyed with lead, copper and other metals for use in ammunition, bearings, and lead storage batteries.

Antimony was detected above the background based PRG (36.5 µg/L) in at least one well in five of the ten AOCs included in this study. There is no indication of wide spread utilization of antimony at PORTS. Therefore, release of antimony at the plant in concentrations sufficient to leach to groundwater is improbable. The scattered detections and the low concentrations, as compared to the PRG, indicate that antimony in groundwater most likely did not result from operational activities at PORTS.

Cobalt - Iron, cobalt and nickel form a triad of metals displaying similar elemental and chemical properties. They are often found together in ores and minerals. Cobalt is a common contaminant in nickel metal. Probable sources of cobalt include coal and fuel oil combustion, and attrition (corrosion through use) of cobalt containing high strength alloys and cemented tungsten carbides (Carson et al 1986).

There is no MCL or risk level established for cobalt. The cobalt PRG for Gallia groundwater is based on the background upper tolerance limit for filtered samples from nine offsite wells (DOE 1996). Cobalt was detected above the PRG in unfiltered samples from five of the nine offsite background wells.

Cobalt was detected above the background based PRG (13 µg/L) in at least one well in seven of the ten AOCs included in this study. In each of these areas, the detections were isolated and not associated with a potential source area. The scattered detections, low concentrations, lack of potential sources, and numerous detections in offsite wells indicate that cobalt in groundwater most likely did not result from operational activities at PORTS.

Thallium – In the natural environment, thallium is widely dispersed as a replacement for potassium in silicates and clays. Thallium has few commercial uses. Prior to being banned in 1972, thallium was commonly used in insecticides and rodenticides. Thallium's primary industrial use is as an electronic coating. In addition, it is recovered and produced as a by-product of zinc and cadmium smelting (Carson et al 1986).

Thallium was detected above the background based PRG (10.5 µg/L) in at least one well in eight of the ten AOCs included in this study. There is no indication of widespread utilization of thallium at PORTS. Therefore, a mechanism capable of releasing thallium over many areas of the plant in concentrations sufficient to leach to groundwater is improbable. The scattered detections and the low concentrations as compared to the PRG (in all but two samples) indicate that thallium in groundwater most likely did not result from operational activities at PORTS.

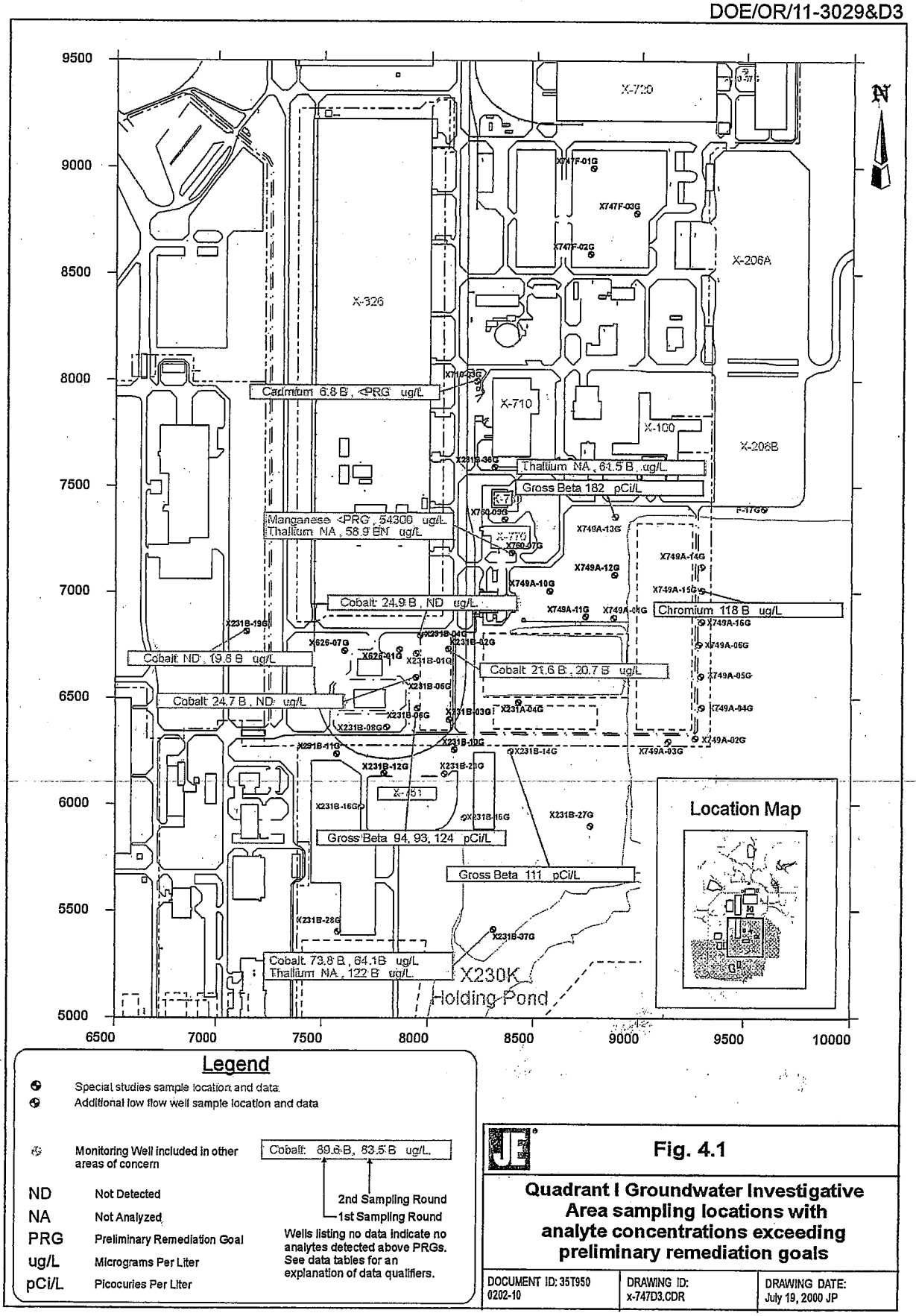
4.1 QUADRANT I GROUNDWATER INVESTIGATIVE AREA

4.1.1 Special Study Results

Twenty-three Gallia wells were sampled utilizing low-flow techniques at the Quadrant I Groundwater Investigative Area. Analytical results for this AOC are included in Table A-1 (Appendix A). The number of occurrences for each analyte detected above MCLs, background values and PRGs is summarized in Table 4.1. The location of samples with values greater than PRGs from both rounds of sampling for Gallia and Berea wells is shown in Figure 4.1.

Table 4.1. Quadrant I Groundwater Investigative Area analytes detected above screening levels

Analyte	Number of Occurrences		
	>MCL	>Background	>PRG
Cadmium	1	1	1
Chromium	0	6	0
Cobalt	N/A	7	7
Manganese	N/A	N/A	1
Nickel	0	5	0
Silver	N/A	9	0
Thallium	3	3	3
Vanadium	N/A	1	0



Legend

- Special studies sample location and data
- Additional low flow well sample location and data
- Monitoring Well included in other areas of concern

Cobalt: 69.6 B, 83.5 B ug/L.
2nd Sampling Round
1st Sampling Round

Wells listing no data indicate no analytes detected above PRGs. See data tables for an explanation of data qualifiers.

ND	Not Detected
NA	Not Analyzed
PRG	Preliminary Remediation Goal
ug/L	Micrograms Per Liter
pCi/L	Picocuries Per Liter

Fig. 4.1

Quadrant I Groundwater Investigative Area sampling locations with analyte concentrations exceeding preliminary remediation goals

DOCUMENT ID: 35T950 0202-10	DRAWING ID: x-747D3.CDR	DRAWING DATE: July 19, 2000 JP

- Four metals (cadmium, cobalt, manganese and thallium) were detected above PRGs at this AOC.
- Eight of the twenty-three wells sampled at this AOC showed detections above PRGs for one or more of these metals.
- Cadmium was detected at X710-03G at a concentration of 6.8 B µg/L, which is slightly above the PRG of 6.5 µg/L.
- Cobalt was detected above the PRG of 13 µg/L at five wells; X231B-02G, X231B-04G, X231B-05G, X231B-19G and X231B-37G; at concentrations ranging from 19.8 B µg/L (X231B-19G) to 73.8 B µg/L (X231B-37G). Cobalt was detected during both rounds of sampling at X231B-02G and X231B-37G.
- Manganese was detected above the PRG of 14,300 µg/L at X760-07G at a concentration of 54,300 µg/L.
- Thallium was detected above the PRG of 10.5 µg/L at three wells; X231B-36G, X231B-37G and X760-07G; at concentrations of 61.5 B µg/L, 122 B µg/L, 58.9 BN µg/L, respectively.

Analytical results and spatial distributions for metals and radionuclides above PRGs are shown in Figure 4.1. Spatial distributions for cadmium, cobalt, manganese, and thallium are not consistent with expected patterns associated with contaminant releases. In addition, analytical values for these metals are only slightly greater than the screening levels (PRGs) selected for each constituent.

A detection of cadmium greater than the selected PRG is isolated to first round sampling at X710-03G; this value is only slightly greater than the PRG.

Detections of cobalt greater than the selected PRG are clustered in the vicinity of the X-231B Oil Biodegradation Plot. Cobalt was detected in five of the X-231B wells during the first round of sampling; X231B-02G and X231B-37G detections were obtained during both rounds of sampling. Although low-flow sampling techniques were employed during both sampling events to reduce the affects of turbidity on laboratory results, abnormally high turbidity values were obtained during the first round of sampling at X231B-04G (163 NTU) and X231B-05G (885 NTU). These turbidity values may have resulted in elevated analytical results for cobalt; second round samples at these locations had much lower turbidity values. All second round cobalt detections were below the selected PRG; (with the exception of X231B-02G and X231B-37G); the selected PRG is based on a background value. Cobalt does not have an established risk level or MCL.

A detection of manganese greater than the selected PRG is isolated to second round sampling at X760-07G; the elevated level of manganese is most likely associated with the injection of sodium permanganate during the implementation of the 1998 oxidant injection pilot project in the area.

Detections of thallium greater than the selected PRG were obtained during second round sampling in three wells. Thallium detections are widely separated and are not consistent with a pattern that would be expected in association with contaminant release.

4.1.2 Additional Groundwater Monitoring Program Low-flow Sampling Results

In addition to the samples collected specifically for this metals special study, 30 wells in the Quadrant I Groundwater Investigative Area were sampled in 1998 and first quarter 1999 using low-flow techniques.

Samples collected quarterly from 19 of the wells were analyzed for barium, cadmium, lead, manganese, nickel, gross alpha, gross beta, technetium, and uranium. Samples from 11 wells (in the vicinity of X-749A Classified Materials Disposal Facility) were collected semiannually and analyzed for arsenic, barium, cadmium, chromium, lead, manganese, mercury, nickel, silver, gross alpha, gross beta, technetium, and uranium. Results from these analyses are included in Appendix B.

Gross Beta was detected above the background screening level of 88 pCi/L during first quarter 1998, fourth quarter 1998, and first quarter 1999 at X231B-06G at activities of 94 pCi/L, 93 pCi/L, and 124 pCi/L, respectively. Gross Beta was also detected above the background screening level during second quarter 1998 at X231B-14G and X749A-13G at activities of 111 pCi/L and 182 pCi/L, respectively. The repeated detection of gross beta above background at X231B-06G corresponds to technetium detected in X231B-06G. Technetium was detected in X231B-06G at activities of 92 pCi/L, 69 pCi/L, and 101 pCi/L, respectively. These levels are well below the PRG for technetium of 3,790 pCi/L. Technetium was not detected at X231B-14G or X749A-13G.

Chromium was detected above the PRG of 100 µg/L during fourth quarter 1998 at X749A-15G at a concentration of 118 B µg/L. This detection of chromium, slightly greater than the PRG, is isolated to one semiannual sampling event at X749A-15G.

4.1.3 Summary – Quadrant I Groundwater Investigative Area

Evaluation of the data from the special study and the additional groundwater monitoring program low-flow sampling indicates isolated detections of metals in groundwater at the Quadrant I Groundwater Investigative Area. Metals concentrations, radiological activities and associated distribution patterns do not indicate metals or radiological contamination problems within this AOC.

4.2 X-120/X-749/PETER KIEWIT LANDFILL AREA

4.2.1 Special Study Results

Nine Gallia wells and two Berea wells were sampled at the X-120/X-749/Peter Kiewit Landfill Area. Analytical results for this AOC are included in Tables A-2a (Gallia wells) and A-2b (Berea wells) in Appendix A. The number of occurrences for each analyte detected above MCLs, background values, and PRGs is summarized in Table 4.2 below. The location of samples with analytical values greater than PRGs/screening levels from both rounds of sampling for Gallia and Berea wells is shown in Figure 4.2.

Table 4.2. X-120/X-749/Peter Kiewit Landfill Area analytes detected above screening levels

Analyte	Number of Occurrences		
	>MCL	>Background	>PRG
Antimony	4	1	1
Chromium	2	4	2
Cobalt	N/A	1	1
Lead	N/A	1	0
Nickel	0	6	0
Silver	N/A	3	0
Thallium	1	1	1
Gross Beta	N/A	1	N/A

- Four metals (antimony, chromium, cobalt and thallium) and one radionuclide indicator (gross beta) were detected above PRGs/screening levels in Gallia wells at this AOC.
- Five of the nine Gallia wells showed detections above PRGs for one or more of these metals.
- Antimony was detected above the PRG of 36.5 µg/L at X749-41G at a concentration of 48.9 B µg/L.
- Chromium was detected above the PRG of 100 µg/L during both rounds of sampling at X749-04G at concentrations of 427 µg/L and 177 B µg/L.
- Cobalt was detected above the PRG of 13 µg/L at X120-10G at a concentration of 20.5 B µg/L.
- Thallium was detected above the PRG of 10.5 µg/L at X120-03G at a concentration of 47.3 B µg/L.
- Gross beta was detected above the background screening level of 88 picoCuries per liter (pCi/L) at X749-26G at an activity of 92 pCi/L.

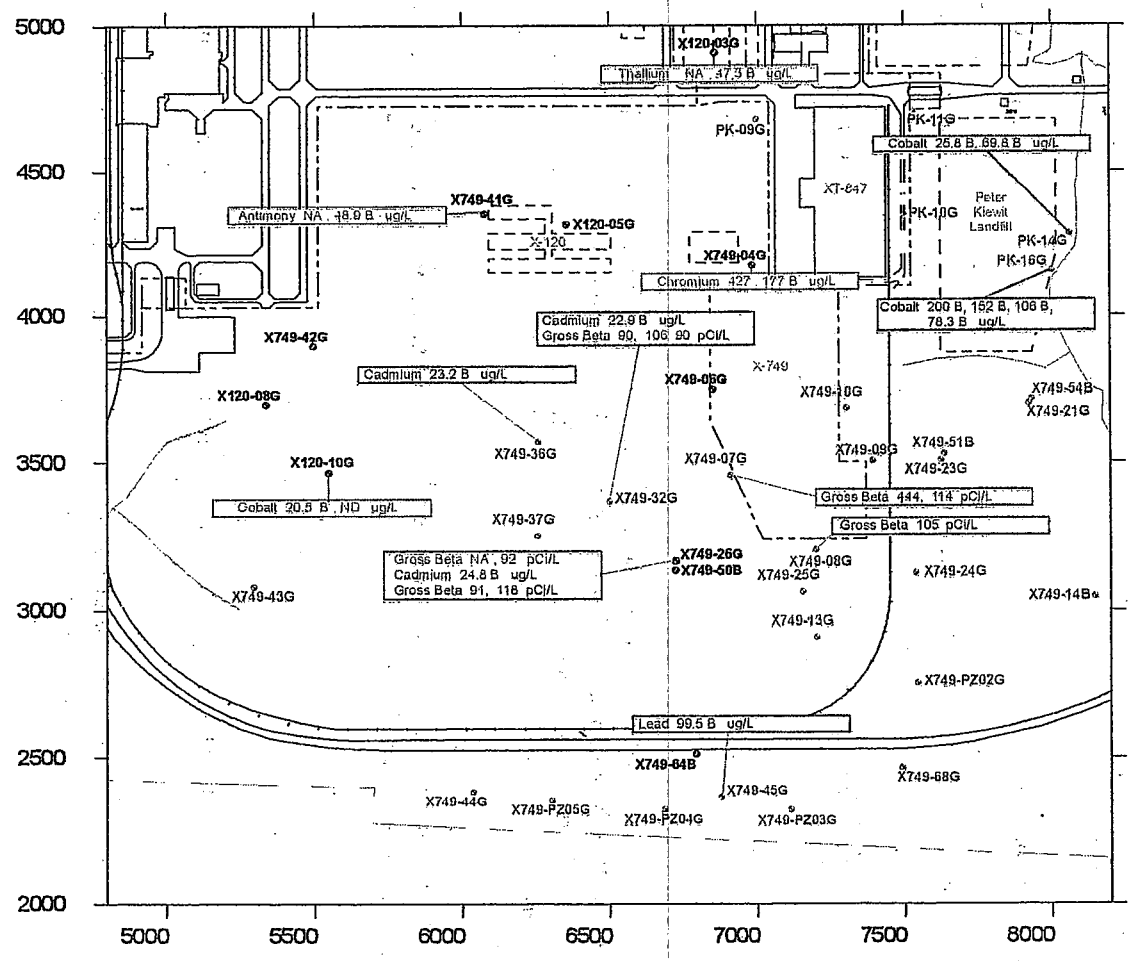
Analytical results and spatial distributions for metals and radionuclides are shown in Figure 4.2. Spatial distributions for antimony, cobalt, thallium, lead, and gross beta are not consistent with expected patterns associated with contaminant releases. In addition, analytical values for these metals are only slightly greater than the screening levels (PRGs) selected for each constituent.

A detection of antimony greater than the selected PRG is isolated to second round sampling at X749-41G; the analytical value is only slightly greater than the selected PRG.

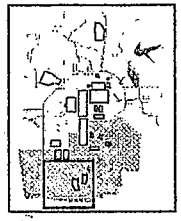
During both rounds of sampling, detections of chromium were obtained upgradient of the X-749 Landfill at a single well, X749-04G. Chromium was not detected on the western edge of the X-749 Landfill at well X749-06G. This suggests that the landfill is not a source for chromium.

A detection of cobalt greater than the selected PRG is isolated to first round sampling at X120-10G; this value is only slightly greater than the PRG. The selected PRG is based on a background value and does not exceed a health based risk value or an MCL.

A detection of thallium greater than the selected PRG is isolated to second round sampling at X120-03G.



Location Map



Legend

- Special studies sample location and data
- Additional low flow well sample location and data

ND	Not Detected
NA	Not Analyzed
PRG	Preliminary Remediation Goal
ug/L	Micrograms Per Liter
pCi/L	Picocuries Per Liter

Cobalt 89.6 B, 83.6 B ug/L

2nd Sampling Round
1st Sampling Round

Wells listing no data indicate no analytes detected above PRGs. See data tables for an explanation of data qualifiers.

Fig. 4.2	**X-120 / X-749 / PK Landfill Area sampling locations with analyte concentrations exceeding preliminary remediation goals**	DOCUMENT ID: 35T950 0202-10	DRAWING ID: x120_749D3.CDR	DRAWING DATE: July 19, 2000 JP

A detection of gross beta activity greater than the background screening level is isolated to X749-26G; this value is only slightly greater than background.

4.2.2 Additional Groundwater Monitoring Program Low-flow Sampling Results

In addition to the samples collected specifically for this metals special study, 32 wells in the X-120/X-749/Peter Kiewit Landfill Area were sampled in 1998 and first quarter 1999 using low-flow techniques. Samples collected semiannually from 18 of the wells were analyzed for cadmium, chromium, lead, gross alpha, gross beta, technetium, and uranium. Samples collected semiannually from three of the wells were analyzed for cadmium, chromium, lead, manganese, nickel, gross alpha, gross beta, technetium, and uranium.

Samples from 11 wells (in the vicinity of the Peter Kiewit Landfill) were collected quarterly and were analyzed for arsenic, cadmium, chromium, cobalt, lead, mercury, nickel, vanadium, gross alpha, gross beta, technetium, and uranium. Results from these analyses are included in Appendix B.

Cobalt was detected above the PRG of 13 µg/L during second, third, and fourth quarters 1998, and first quarter 1999 at PK-16G at concentrations of 200 B µg/L, 152 B µg/L, 106 B µg/L, and 78.3 B µg/L respectively. Cobalt was also detected above the PRG during second quarter 1998, and first quarter 1999 at PK-14G at concentrations of 25.8 B µg/L and 69.8 B µg/L, respectively.

Cadmium was detected above the PRG of 6.5 µg/L first quarter 1999 at X749-26G, X749-32G, and X749-36G at concentrations of 24.8 B µg/L, 22.9 B µg/L, and 23.2 B µg/L, respectively.

Lead was detected above the PRG of 50 µg/L during third quarter 1998 at X749-45G at a concentration of 99.5 B µg/L.

Gross Beta was detected above the background screening level of 88 pCi/L during multiple quarters in 1998 at X749-07G, X749-08G, X749-26G, and X749-32G at activities ranging from 90 pCi/L (X749-32G) to 444 pCi/L (X749-07G). The repeated detection of gross beta above background corresponds with technetium detections in several of the wells within the X-120/X-749/PK-Landfill Area; technetium levels are below the associated PRG of 3790 pCi/L.

Cobalt was the only metal detected at levels greater than the PRG during multiple quarters of sampling. These detections were isolated to the Peter Kiewit Landfill Area; no other metals were detected above PRGs within the Peter Kiewit Landfill Area.

4.2.3 Summary – X-120/X-749/Peter Kiewit Landfill Area

Evaluation of the data from the special study and the additional groundwater monitoring program low-flow sampling indicates isolated detections of metals in groundwater at the X-120/X-749/PK-Landfill Area.

Cobalt was the only metal detected at levels greater than the PRG in adjacent wells during multiple quarters of sampling. These results were collected from wells located adjacent to the Peter Kiewit Landfill, so a release from the landfill cannot be ruled out. However, these two wells are screened within the Big Run Creek alluvium composed of sediment and reworked Sunbury and Berea deposits. Background levels for

sediment and alluvium have not been developed, and the background UTL for cobalt in Berea groundwater is seven times higher than the Gallia. A release of inorganic constituents from the landfill is not likely because no other metals exceeded PRGs in these wells nor within the Peter Kiewit Landfill Area.

Routine groundwater monitoring at the PK Landfill includes cobalt and should be sufficient to evaluate any contaminant release from the landfill. Other metal concentrations, radiological activities and associated distribution patterns do not indicate metals or radiological contamination problems within this AOC.

4.3 QUADRANT II GROUNDWATER INVESTIGATIVE AREA

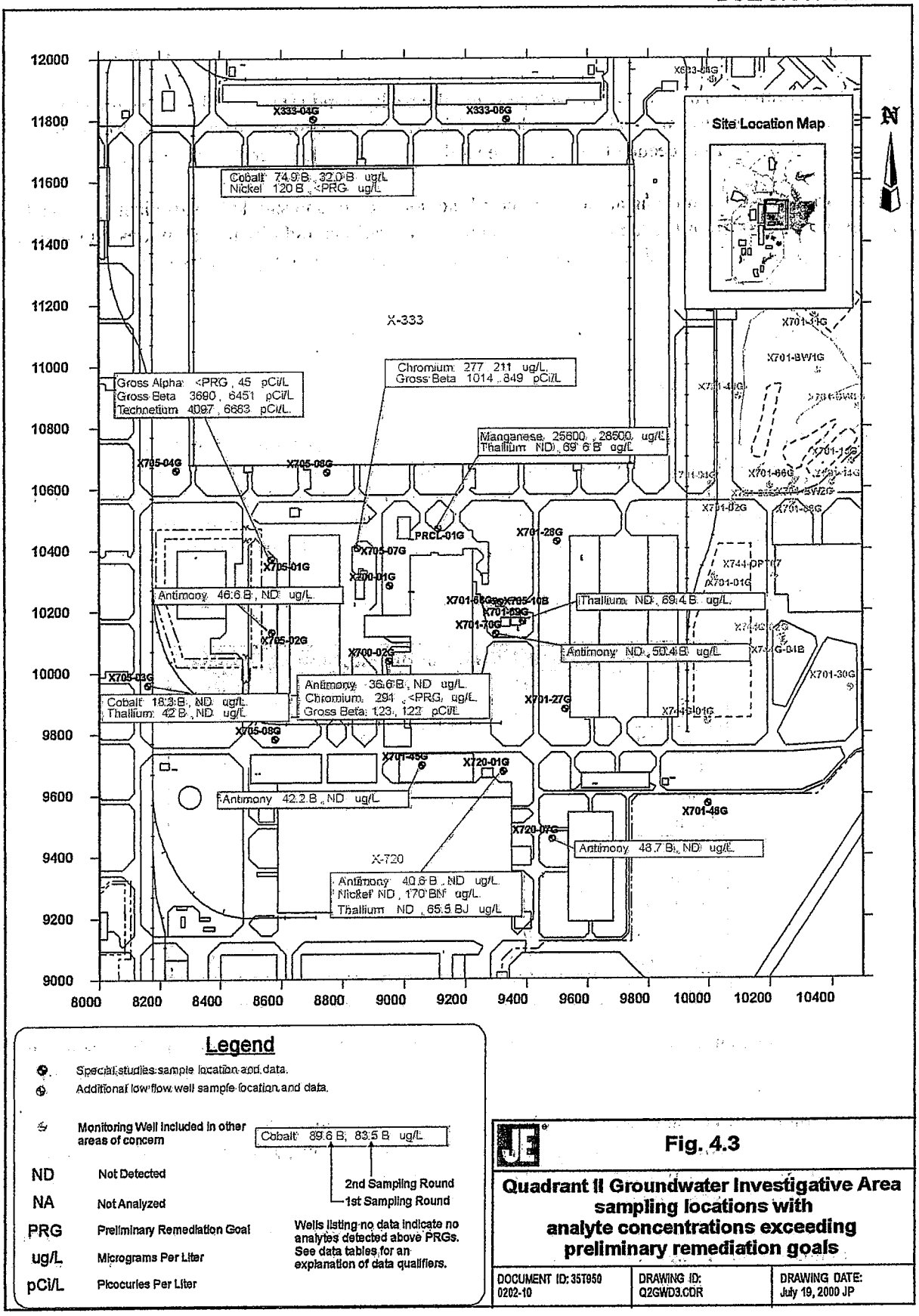
4.3.1 Special Study Results

Twenty-one Gallia wells and one Berea well were sampled at the Quadrant II Groundwater Investigative Area. Analytical results for this AOC are included in Tables A-3a (Gallia wells) and A-3b (Berea wells) in Appendix A. The number of occurrences for each analyte detected above MCLs, background values and PRGs is summarized in Table 4.3 below. The location of samples with analytical values greater than PRGs/screening levels from both rounds of sampling for Gallia and Berea wells is shown in Figure 4.3.

Table 4.3. Quadrant II Groundwater Investigative Area analytes detected above screening levels

Analyte	Number of Occurrences		
	>MCL	>Background	>PRG
Antimony	15	6	6
Chromium	3	9	3
Cobalt	N/A	3	3
Lead	N/A	2	0
Manganese	N/A	N/A	2
Nickel	2	9	2
Silver	N/A	33	0
Thallium	4	4	4
Gross Alpha	N/A	1	N/A
Gross Beta	N/A	6	N/A
Technetium	N/A	N/A	2

- Six metals (antimony, chromium, cobalt, manganese, nickel and thallium) and three radionuclides (gross alpha, gross beta, and technetium) were detected above PRGs/screening levels in Gallia wells at this AOC.
- No analytes were detected above PRGs in Berea wells at this AOC.
- Antimony was detected above the PRG of 36.5 µg/L at six wells; X700-02G, X701-45G, X701-70G, X705-02G, X720-01G and X720-07G; at concentrations ranging from 36.6 B µg/L (X700-02G) to 50.4 B µg/L (X701-70G).
- Chromium was detected above the PRG of 100 µg/L at X700-02G and X705-07G at concentrations ranging from 211 µg/L (X705-07G) to 291 µg/L (X700-02G). Chromium was detected during both rounds of sampling at X705-07G.



Legend

- Special studies sample location and data.
- Additional low flow well sample location and data.
- Monitoring Well included in other areas of concern

Cobalt 89.6 B, 83.5 B ug/L
(2nd Sampling Round / 1st Sampling Round)

ND	Not Detected
NA	Not Analyzed
PRG	Preliminary Remediation Goal
ug/L	Micrograms Per Liter
pCi/L	Picocuries Per Liter

Wells listing no data indicate no analytes detected above PRGs. See data tables for an explanation of data qualifiers.

Fig. 4.3

Quadrant II Groundwater Investigative Area sampling locations with analyte concentrations exceeding preliminary remediation goals

DOCUMENT ID: 35T950 0202-10	DRAWING ID: Q2GWD3.CDR	DRAWING DATE: July 19, 2000 JP

- Cobalt was detected above the PRG of 13 µg/L at X705-03G and X333-04G at concentrations ranging from 18.3 B µg/L to 74.9 B µg/L. Cobalt was detected during both rounds of sampling at X333-04G.
- Manganese was detected above the PRG of 14,300 µg/L during both rounds of sampling at PRCL-01G at concentrations of 25,600 µg/L and 28,500 µg/L.
- Nickel was detected above the PRG of 100 µg/L at X333-04G and X720-01G at concentrations of 120 B µg/L and 170 BN µg/L, respectively.
- Thallium was detected above the PRG of 10.5 µg/L at four wells; PRCL-01G, X701-69G, X705-03G and X720-01G; at concentrations ranging from 42 B µg/L (X705-03G) to 69.6 B µg/L (PRCL-01G).
- Gross alpha was detected above the PRG of 43 pCi/L at X705-01G at a concentration of 45 pCi/L.
- Gross beta was detected above the PRG of 88 pCi/L at three wells; X700-02G, X705-01G and X705-07G; at activities ranging from 122 pCi/L (X700-02G) to 6,451 pCi/L (X705-01G). Gross beta was detected during both rounds of sampling at each of these wells.
- Technetium was detected above the PRG of 3,790 pCi/L during both rounds of sampling at X705-01G at activities of 4,097 pCi/L and 6,683 pCi/L.

During both rounds of sampling, detections of technetium greater than the selected PRG were obtained at a single well location, X705-01G.

During both rounds of sampling, detections of antimony greater than the selected PRG were obtained. Five wells had detections greater than the PRG in first round sampling; a separate well, X701-70G had detection greater than the PRG in second round sampling. Results for antimony are not substantially greater than background.

During both rounds of sampling, detections of chromium greater than the selected PRG were obtained at a single well, X705-07G; an additional detection during the first round was obtained at X700-02G. Chromium was below the PRG or not detected in wells between and adjacent to these two wells.

Detections of cobalt greater than the selected PRG were obtained in two locations, X333-04G and X705-03G. Cobalt was detected at X333-04G during both rounds of sampling. All second round cobalt detections (with the exception of X333-04G) were below the selected PRG; the selected PRG is based on a background value. No MCL or risk values exist for cobalt.

During both rounds of sampling, detections of manganese greater than the selected PRG were obtained at a single well, PRCL-01G.

During both rounds of sampling, detections of nickel greater than the selected PRG were obtained at isolated well locations, X333-04G and X720-01G; these well locations are widely separated.

During both rounds of sampling, detections of thallium greater than the selected PRG were obtained at isolated well locations, PRCL-01G, X701-69G, X705-03G and X720-01G; these well locations are widely separated and there is no apparent source for thallium connected to plant operational activities. The result for thallium at X720-01G (65.5BJ µg/L) was qualified as estimated due to the calibration verification not meeting acceptance limits.

A detection of gross alpha greater than the selected screening level is isolated to X705-01G; this value is only slightly greater than the PRG.

During both rounds of sampling, detections of gross beta greater than the selected screening level were obtained at three well locations, X705-01G, X705-07G and X700-02G. The detections of gross beta above background in wells in this AOC are due to low levels of technetium. Technetium activities measured from these wells during these sampling events ranged from non-detected (X749-26G) to 512 pCi/L (X749-07G). These levels are well below the PRG for technetium of 3790 pCi/L.

4.3.2 Additional Groundwater Monitoring Program Low-flow Sampling Results

In addition to the samples collected specifically for this metals special study, three wells in the Quadrant II Groundwater Investigative Area were sampled during the first quarter 1999 using low-flow techniques.

Samples collected from X701-68G, X701-69G, and X701-70G were analyzed for manganese, gross alpha, gross beta, technetium, and uranium. Additionally, groundwater collected from X701-70G during the first quarter 1998 was analyzed for antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel, silver, thallium, vanadium, gross alpha, gross beta, technetium, and uranium. Results from these analyses are included in Appendix B.

There were no detections of constituents above PRGs/screening levels from this additional low-flow data.

4.3.3 Summary – Quadrant II Groundwater Investigative Area

Evaluation of the data from the special study and the additional groundwater monitoring program low-flow sampling indicates isolated detections of metals in groundwater at the Quadrant II Groundwater Investigative Area; constituent values and distribution patterns do not indicate a metals contamination problem within this AOC.

Technetium, and associated gross beta activity, was detected at levels in excess of the PRG in the vicinity of the X-705 Decontamination Building. Groundwater extracted from the X-705 sumps is treated at the X-622T Groundwater Treatment Facility. Effluent from X-622T is monitored by DOE for radiological parameters and is treated at the X-6619 Sewage Treatment Plant prior to discharge to the Scioto River. Effluent monitoring indicates that technetium and gross beta are being removed.

4.4 X-701B HOLDING POND AREA

4.4.1 Special Study Results

Nineteen Gallia wells were sampled at the X-701B Holding Pond. Analytical results for this AOC are included in Table A-4 in Appendix A. The number of occurrences for each analyte detected above MCLs, background values and PRGs is summarized in Table 4.4 below. Exceedances of PRGs/screening levels from both rounds of sampling for both Gallia and Berea wells are shown on Figure 4.4.

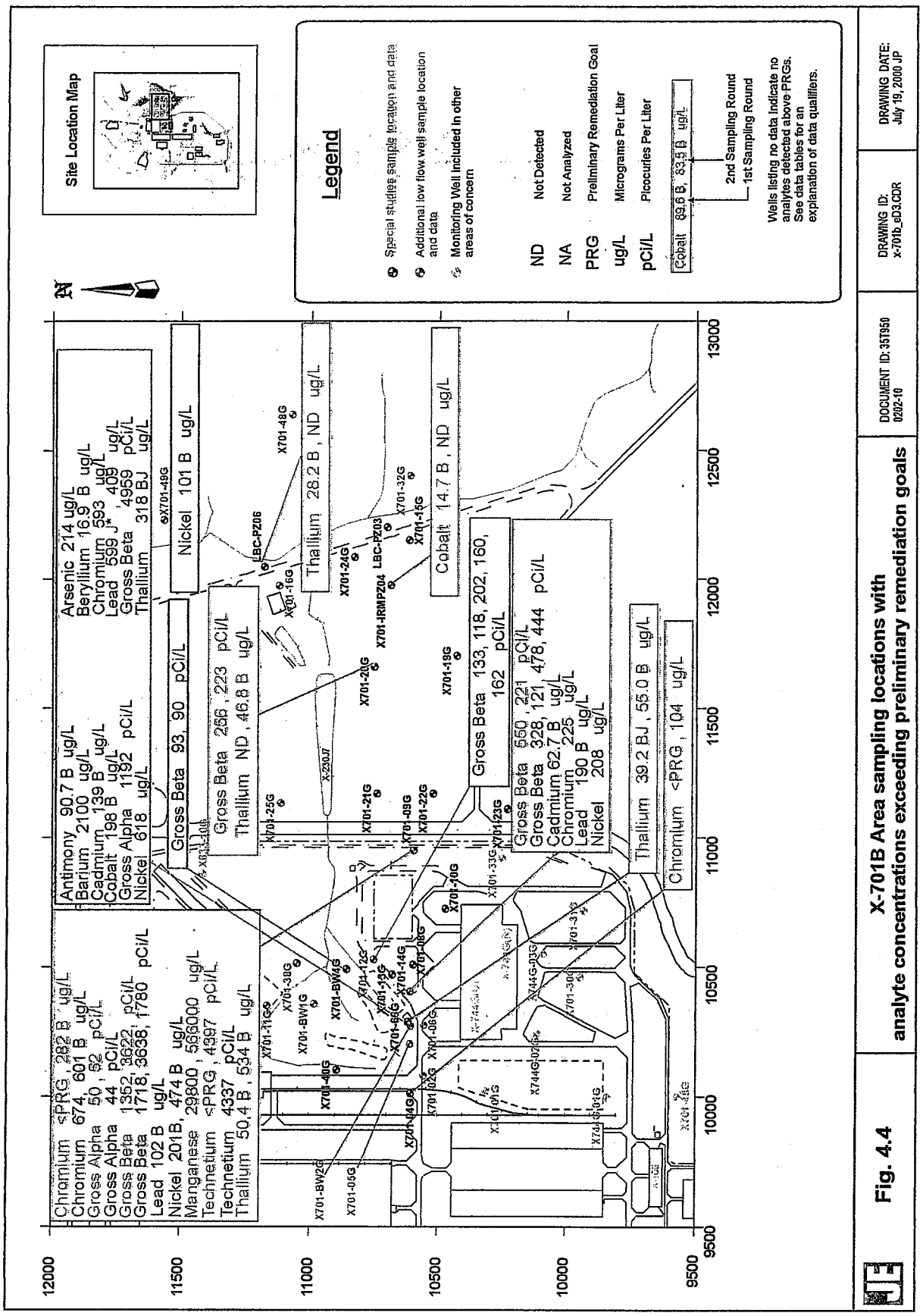
Table 4.4. X-701B Holding Pond Area analytes detected above screening levels

Analyte	Number of Occurrences		
	>MCL	>Background	>PRG
Antimony	6	0	0
Chromium	2	6	2
Cobalt	N/A	1	1
Manganese	N/A	N/A	2
Nickel	0	11	0
Silver	N/A	5	0
Thallium	6	6	6
Gross Alpha	N/A	2	N/A
Gross Beta	N/A	6	N/A
Technetium	N/A	N/A	1

- Four metals (chromium, cobalt, manganese, and thallium) and three radionuclides (gross alpha, gross beta and technetium) were detected above PRGs/screening levels at this AOC.
- Chromium was detected above the PRG of 100 µg/L at X701-04G and X701-09G at concentrations of 104 µg/L and 282 B µg/L, respectively.
- Cobalt was detected above the PRG of 13 µg/L at X701-IRMPZ04 at a concentration 14.7 B µg/L.
- Manganese was detected above the PRG of 14,300 µg/L during both rounds of sampling at X701-09G at concentrations of 29,800 µg/L and 566,000 µg/L.
- Thallium was detected above the PRG of 10.5 µg/L at four wells; LBC-PZ06, X701-09G, X701-20G and X701-66G; at concentrations ranging from 28.2 B µg/L (LBC-PZ06) to 534 B µg/L (X701-09G). The result for thallium at X701-66G (39.2 BJ µg/L) was qualified as estimated due to the interference check not meeting quality control limits. Thallium was detected above the PRG during both sampling events at two wells, X701-09G and X701-66G.
- Gross alpha was detected above the background screening level of 43 pCi/L during both rounds of sampling at X701-09G at activities of 50 pCi/L and 52 pCi/L.
- Gross beta was detected above the background screening level of 88 pCi/L at three wells; X701-09G, X701-14G and X701-20G; at activities ranging from 221 pCi/L (X701-14G) to 3,622 pCi/L (X701-09G). Gross beta was detected during both rounds of sampling at each of these wells.
- Technetium was detected above the PRG of 3,790 pCi/L at X701-09G at an activity of 4,397 pCi/L.

Analytical results and spatial distributions for metals and radionuclides are shown in Figure 4.4. Spatial distributions for chromium, cobalt, manganese, thallium, gross alpha, gross beta, and technetium are not consistent with expected patterns associated with contaminant releases. In addition, analytical values for these metals are only slightly greater than the screening levels (PRGs) selected for each constituent.

During the second round of sampling, detections of chromium greater than the selected PRG were obtained at wells, X701-04G and X701-09G. The analytical value for chromium at X701-04G was only slightly greater than the selected PRG.


Site Location Map
Legend
Special studies sample location and data
Additional low flow well sample location and data
Monitoring Well included in other areas of concern
ND Not Detected
NA Not Analyzed
PRG Preliminary Remediation Goal
ug/L Micrograms Per Liter
pCi/L Picocuries Per Liter
Cobalt 89.6 B, 83.9 B ug/L
2nd Sampling Round
1st Sampling Round
Wells listing no data indicate no analytes detected above PRGs. See data tables for an explanation of data qualifiers.
Chromium <PRG, 282 B ug/L
Chromium 674, 601 B ug/L
Gross Alpha 50, 62 pCi/L
Gross Alpha 44 pCi/L
Gross Beta 1352, 3622 pCi/L
Gross Beta 1718, 3638, 1780 pCi/L
Lead 102 B ug/L
Nickel 201B, 474 B ug/L
Manganese 29800, 566000 ug/L
Technetium <PRG, 4997 pCi/L
Technetium 4337 pCi/L
Thallium 50.4 B, 534 B ug/L
Antimony 90.7 B ug/L
Barium 2100 ug/L
Cadmium 139 B ug/L
Cobalt 198 B ug/L
Gross Alpha 1192 pCi/L
Nickel 618 ug/L
Gross Beta 93, 90 pCi/L
Arsenic 214 ug/L
Beryllium 16.9 B ug/L
Chromium 593 ug/L
Lead 599 J*, 409 ug/L
Gross Beta 4959 pCi/L
Thallium 318 BJ ug/L
Nickel 101 B ug/L
Gross Beta 266, 223 pCi/L
Thallium ND, 46.8 B ug/L
Thallium 28.2 B, ND ug/L
Cobalt 14.7 B, ND ug/L
Gross Beta 133, 118, 202, 160, 162 pCi/L
Gross Beta 560, 221 pCi/L
Gross Beta 328, 121, 478, 444 pCi/L
Cadmium 62.7 B ug/L
Chromium 225 ug/L
Lead 190 B ug/L
Nickel 208 ug/L
Thallium 39.2 BJ, 55.0 B ug/L
Chromium <PRG, 104 ug/L
X701-BW2G
X701-05G
X701-40G
X701-BW1G
X701-30G
X701-31G
X701-12G
X701-13G
X701-14G
X701-06G
X701-02G
X701-01G
X701-45G
X701-46G
X701-25G
X701-21G
X701-09G
X701-22G
X701-23G
X701-33G
X701-20G
X701-16G
X701-24G
X701-IRMPZ04
LBC-PZ03
LBC-PZ06
X701-48G
X701-49G
X701-32G
X701-15G
X701-19G
X701-26G
X701-27G
X744G-02G
X744G-03G
X744G-01G
X-230J
12000
11500
11000
10500
10000
9500
13000
12500
12000
11500
11000
10500
10000
9500
N
Fig. 4.4
X-701B Area sampling locations with analyte concentrations exceeding preliminary remediation goals
DOCUMENT ID: 35T950 0202-10
DRAWING ID: x-701b_e03.CDR
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A detection of cobalt greater than the selected PRG is isolated to X701-IRMPZ04 during the first round of sampling. This single detection is only slightly greater than the selected PRG. The selected PRG is based on a background value.

During both rounds of sampling, detections of manganese greater than the selected PRG were obtained at a single well, X701-09G. The elevated level of manganese is likely associated with the injection of sodium permanganate during the implementation of the oxidant injection pilot project in the area.

During both rounds of sampling, detections of thallium greater than the selected PRG were obtained at isolated well locations, X701-09G, X701-20G, X701-66G and LBC-PZ06; these well locations are widely separated and there is no apparent source for thallium connected to plant operational activities.

During both rounds of sampling, detections of gross alpha greater than the selected PRG were obtained at a single well location, X701-09G; these values are only slightly greater than the selected PRG.

During both rounds of sampling, detections of gross beta greater than the selected PRG were obtained at three well locations, X701-09G, X701-14G and X701-20G. The detections of gross beta above background in wells in this AOC are due to low levels of technetium. Technetium activities measured from these wells during these sampling events ranged from 225 pCi/L (X701-14G) to 4,397 pCi/L (X701-09G).

A detection of technetium greater than the selected PRG was obtained during the second round of sampling at a single well location, X701-09G.

4.4.2 Additional Groundwater Monitoring Program Low-flow Sampling Results

In addition to the samples collected specifically for this metals special study, 27 Gallia wells in the X-701B Area were sampled in 1998 and first quarter 1999 using low-flow techniques. Samples collected quarterly from the 27 wells were analyzed for cadmium, chromium, lead, nickel, gross alpha, gross beta, technetium, and uranium. A sample collected in February 1998 from X701-BW02G was analyzed for antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel, silver, thallium, vanadium, gross alpha, gross beta, technetium, and uranium. Results from these analyses are included in Appendix B.

Antimony was detected above the PRG of 36.5 µg/L at X701-BW2G at a concentration of 90.7 B µg/L. Arsenic was detected above the PRG of 92 µg/L at X701-BW2G at a concentration of 214 µg/L. Barium was detected above the PRG of 2000 µg/L at X701-BW2G at a concentration of 2100 µg/L. Beryllium was detected above the PRG of 6.5 µg/L at X701-BW2G at a concentration of 16.9 B µg/L. Cadmium was detected above the PRG of 6.5 µg/L at X701-BW2G and X701-14G at concentrations of 139 B µg/L and 62.7B µg/L, respectively. Chromium was detected above the PRG of 100 µg/L during fourth quarter 1998 and first quarter 1999 at X701-09G at concentrations of 674 µg/L and 601B µg/L, respectively. Chromium was also detected above the PRG at X701-BW2G and X701-14G at concentrations of 593 µg/L and 225 µg/L, respectively. Cobalt was detected above the PRG of 13 µg/L at X701-BW2G at a concentration of 198 B µg/L. Lead was detected above the PRG of 50 µg/L at X701-BW2G, X701-09G, and X701-14G at concentrations of 599 J* µg/L, 102 B µg/L, and 190 B µg/L, respectively. Nickel was detected above the PRG of 100 µg/L during fourth quarter 1998 and first quarter 1999 at X701-09G at concentrations of 201 B µg/L and 474 B µg/L, respectively. Nickel was also detected above the PRG of 100 µg/L at

X701-BW2G, X701-14G, and X701-49G at concentrations of 618 µg/L, 208 µg/L, and 101 B µg/L, respectively. Thallium was detected above the PRG of 10.5 µg/L at X701-BW2G at a concentration of 318 BJ µg/L.

Gross Alpha was detected above the background screening level of 43 pCi/L at X701-09G and X701-BW2G. Activities detected for these well locations were 44 pCi/L and 1,192 pCi/L, respectively.

Gross Beta was detected above the background screening level of 88 pCi/L during multiple quarters at X701-09G, X701-12G, X701-14G, X701-BW2G and X701-BW4G. Activities detected at these well locations ranged from 90 pCi/L (X701-BW4G) to 4,959 pCi/L (X701-BW2G).

Technetium was detected above the PRG of 3,790 pCi/L at X701-09G at an activity of 4,337 pCi/L. All results above PRGs/screening levels are shown on Figure 4.4.

Numerous metal and radiological constituents were detected above PRGs/screening levels in well X701-BW2G and X701-09G. Historically, dense nonaqueous phase liquid (DNAPL) consisting primarily of separate phase TCE has been measured in X701-BW2G; and high concentrations of TCE indicative of DNAPL were detected in X701-09G. Several remediation technology treatability studies have been conducted in the immediate vicinity of these wells. These studies were conducted to determine the effectiveness of these technologies in removing/breaking down TCE and DNAPL. These remediation efforts include DNAPL solubilization test (surfactant flooding) in 1996, oxidant injection and recirculation in 1997 and steam stripping and hydrous pyrolysis/oxidation in 1998/1999. It is not clear if the metals detected are entrained in the DNAPL, or if geochemical effects from the DNAPL or treatability studies mobilized natural metals from the saturated soils.

4.4.3 Summary – X-701B Holding Pond Area

Evaluation of the data from the special study and the additional groundwater monitoring program low-flow sampling indicates detections of several metals in groundwater at the X-701B Holding Pond Area; constituent values and distribution patterns indicate metals contamination located centrally within the VOC plume. Two wells X701-BW2G and X701-09G have an array of metals above PRGs. These wells are separated by wells with lower metals concentrations (from non-detect to less than PRGs).

Technetium, gross beta activity, and gross alpha activity were detected at levels in excess of the PRG/screening levels in the central portion of the X-701B area groundwater VOC plume. Groundwater extracted from the X-701B Holding Pond Area is treated at the X-623 Groundwater Treatment Facility. Effluent from X-623 is monitored by DOE for radiological parameters prior to discharge to the X-6619 Sewage Treatment Facility. Effluent monitoring indicates that gross alpha, technetium, and gross alpha are being removed.

4.5 X-744G BULK STORAGE BUILDING AREA

4.5.1 Special Study Results

Four Gallia wells were sampled at the X-744G Bulk Storage Building Area. Analytical results for this AOC are included in Table A-5 in Appendix A. The number of occurrences for each analyte detected above MCLs, background values and PRGs is summarized in Table 4.5 below. Exceedances of PRGs from both rounds of sampling for both Gallia and Berea wells are shown on Figure 4.5.

Table 4.5. X-744G Bulk Storage Building Area analytes detected above screening levels

Analyte	Number of Occurrences		
	>MCL	>Background	>PRG
Antimony	2	2	2
Beryllium	2	0	0
Cadmium	7	6	6
Cobalt	N/A	4	4
Lead	N/A	1	0
Nickel	6	7	6
Silver	N/A	8	0
Thallium	4	3	3
Vanadium	N/A	3	0

- Five metals (antimony, cadmium, cobalt, nickel, and thallium) were detected above PRGs at this AOC. Antimony was detected above the PRG of 36.5 µg/L at X701-01G and X744G-02G at concentrations of 209 B µg/L and 46.7 B µg/L, respectively.
- Cadmium was detected above the PRG of 6.5 µg/L during both rounds of sampling at X701-01G, X744G-01G and X744G-02G at concentrations ranging from 15.7 B µg/L (X701-01G) to 132 B µg/L (X744G-02G).
- Cobalt was detected above the PRG of 13 µg/L at X701-01G, X744G-01G and X744G-02G at concentrations ranging from 27.7 B µg/L (X744G-01G) to 192 B µg/L (X744G-02G). Cobalt was detected during both rounds of sampling at X744G-01G.
- Nickel was detected above the PRG of 100 µg/L during both rounds of sampling at X701-01G, X744G-01G and X744G-02G at concentrations ranging from 189 B µg/L (X701-01G) to 1,310 µg/L (X744G-02G).
- Thallium was detected above the PRG of 10.5 µg/L at X701-01G, X744G-01G and X744G-02G at concentrations of 66.2 B µg/L, 17.7 N µg/L and 13.9 N µg/L, respectively.

Analytical results and spatial distributions for metals are shown in Figure 4.5. Spatial distributions for antimony, cobalt, lead, and thallium are not consistent with expected patterns associated with contaminant releases. Cadmium and nickel were consistently detected in three adjacent wells.

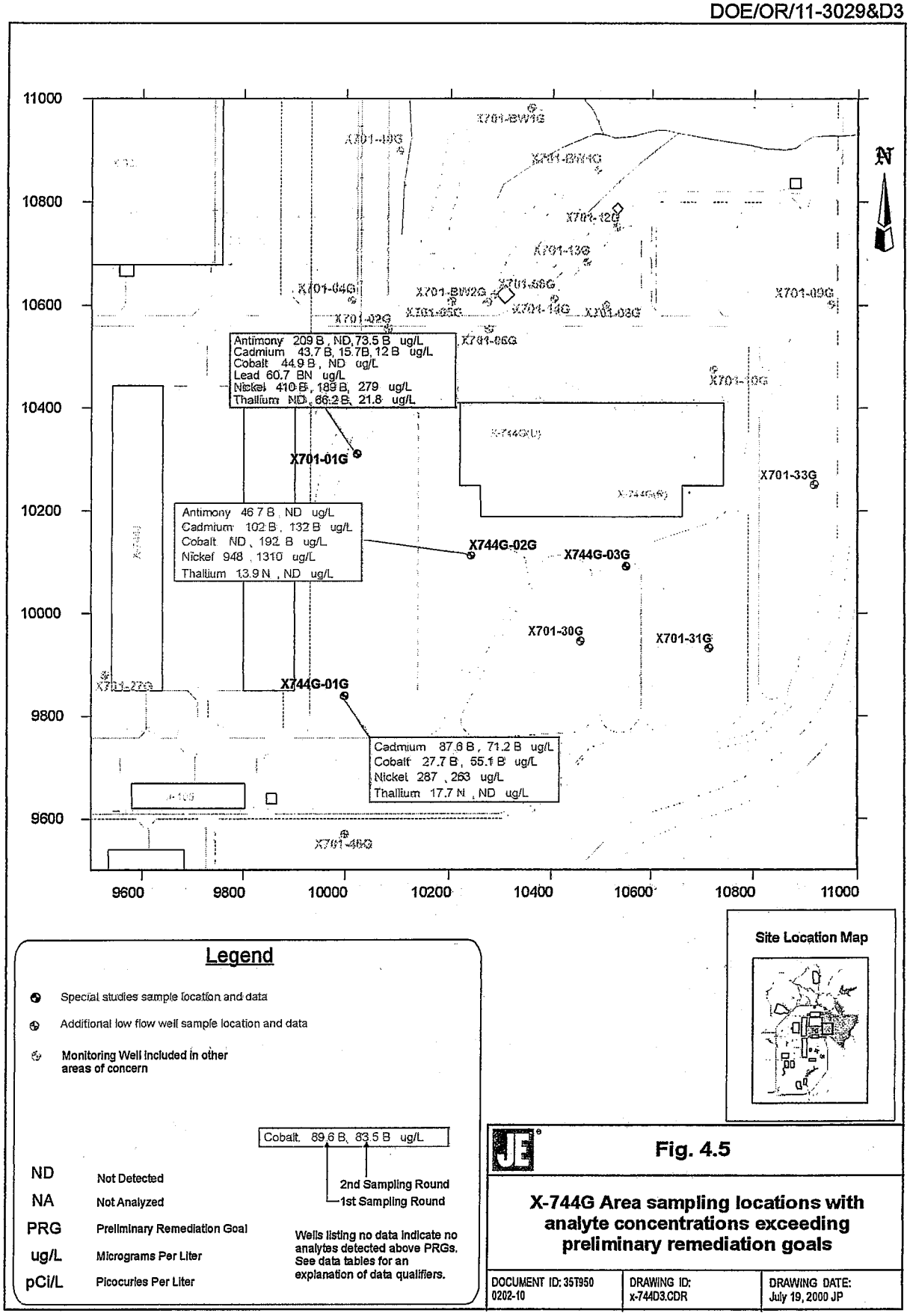

Fig. 4.5

X-744G Area sampling locations with analyte concentrations exceeding preliminary remediation goals

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During the first round of sampling, detections of antimony greater than the selected PRG were obtained in two wells, X701-01G and X744G-02G. Antimony was not detected above the PRG during the second round of sampling.

During both rounds of sampling, detections of cadmium greater than the selected PRG were obtained at the three wells sampled, X701-01G, X744G-01G and X744G-02G.

Detections of cobalt greater than the selected PRG were obtained at three of the four wells sampled, X701-01G, X744G-01G and X744G-02G. The only well in which cobalt was detected in both rounds of sampling was X744G-01G. No MCL or risk values exist for cobalt.

During both rounds of sampling, detections of nickel greater than the selected PRG were obtained at three well locations, X701-01G, X744G-01G and X744G-02G. The value for X774G-02G (1,310 µg/L) is more than an order of magnitude greater than the selected PRG.

Detections of thallium greater than the selected PRG were obtained at two well locations X744G-01G and X744G-02G during the first round of sampling and at X701-01G during the second round of sampling. There is no apparent source for thallium connected to plant operational activities.

4.5.2 Additional Groundwater Monitoring Program Low-flow Sampling Results

In addition to the samples collected specifically for this metals special study, 4 Gallia wells in the X-744G Area were sampled in 1998 and first quarter 1999 using low-flow techniques. Samples collected quarterly from two of the wells (X701-30G and X701-31G) were analyzed for cadmium, chromium, lead, nickel, gross alpha, gross beta, technetium, and uranium. Samples collected in July 1998 from each of the four wells were analyzed for antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel, silver, thallium, vanadium, gross alpha, gross beta, technetium, and uranium. Results from these analyses are included in Appendix B.

Antimony, cadmium, lead, nickel, and thallium were detected above PRGs in X701-01G. Antimony was detected above the PRG of 36.5 µg/L at X701-01G at a concentration of 73.5 B µg/L. Cadmium was detected above the PRG of 6.5 µg/L at X701-01G at a concentration of 12 B µg/L. Lead was detected above the PRG of 50 µg/L at X701-01G at a concentration of 60.7 BN µg/L. Nickel was detected above the PRG of 100 µg/L at X701-01G at a concentration of 279 µg/L. Thallium was detected above the PRG of 10.5 µg/L at X701-01G at a concentration of 21.8 µg/L.

4.5.3 Summary – X-744G Bulk Storage Building Area

Evaluation of the data from the special study and the additional groundwater monitoring program low-flow sampling indicates detections of cadmium and nickel in three adjacent wells southwest of the X-744G Bulk

Storage Building. These wells are bounded by wells where cadmium and nickel concentrations were either below detection limits or below background (e.g., X701-02G and X701-06G to the north; X701-30G, X701-31G, X701-33G to the east; X701-46G to the south; and X701-27G to the west). A review of soil data in this area did not indicate contaminant sources for cadmium or nickel.

4.6 X-633 PUMP HOUSE AND COOLING TOWERS AREA

4.6.1 Special Study Results

Three Gallia wells were sampled at the X-633 Pump House and Cooling Towers Area. Analytical results for this AOC are included in Table A-6 in Appendix A. The number of occurrences for each analyte detected above MCLs, background values and PRGs is summarized in Table 4.6 below. Exceedances of PRGs/screening levels from both rounds of sampling for both Gallia and Berea wells are shown on Figure 4.6.

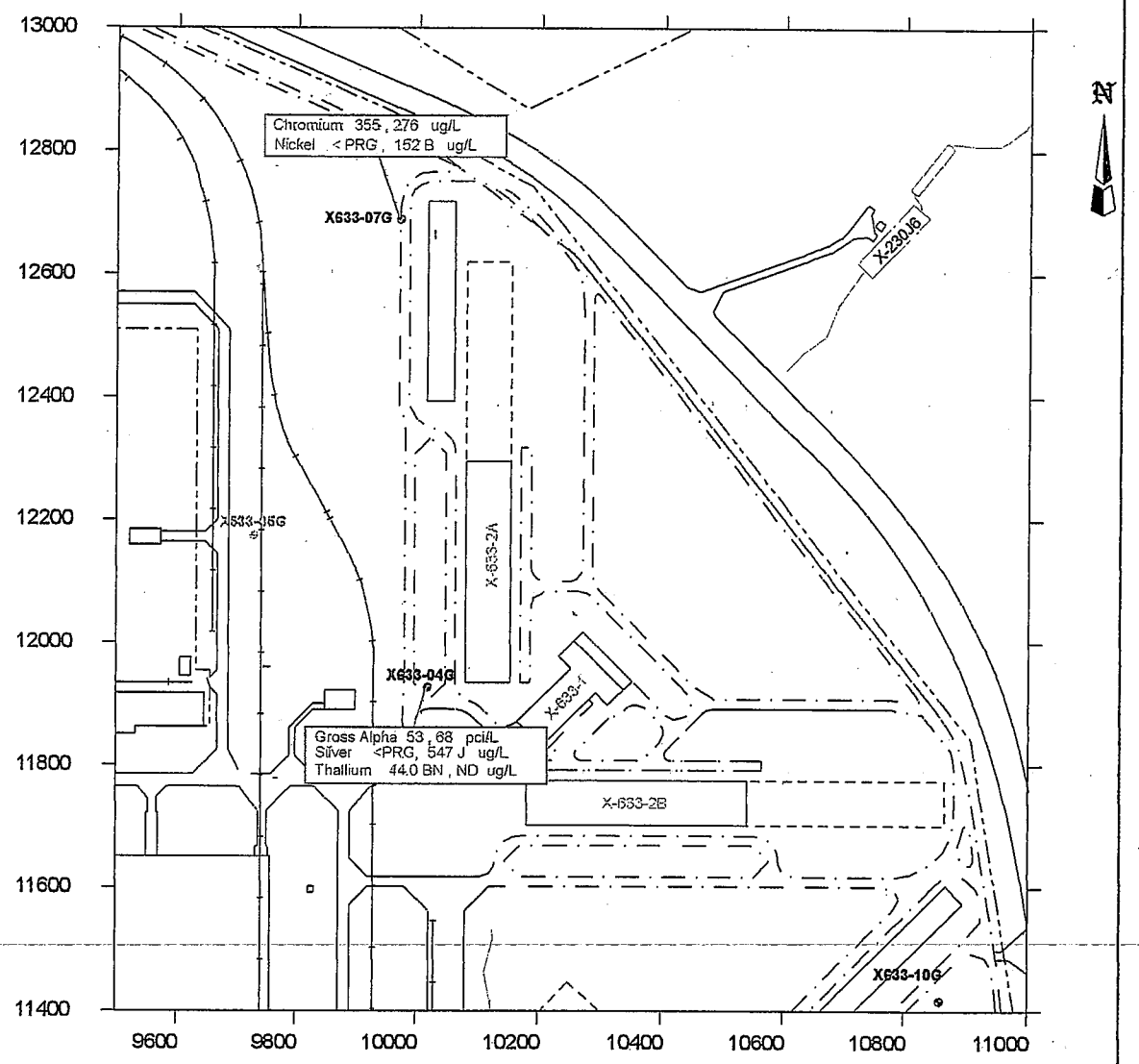
Table 4.6. X-633 Pump House and Cooling Tower Area analytes detected above screening levels

Analyte	Number of Occurrences		
	>MCL	>Background	>PRG
Chromium	2	3	2
Nickel	1	4	1
Silver	N/A	6	1
Thallium	1	1	1
Gross Alpha	N/A	2	N/A

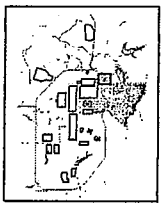
- Four metals (chromium, nickel, silver and thallium) and one radionuclide (gross alpha) were detected above PRGs/screening levels at this AOC.
- Chromium was detected above the PRG of 100 µg/L during both rounds of sampling at X633-07G at concentrations of 355 µg/L and 276 µg/L.
- Nickel was detected above the PRG of 100 µg/L at X633-07G at a concentration of 152B µg/L.
- Silver was detected above the PRG of 509 µg/L at X633-04G at a concentration of 547J µg/L. The result for silver at X633-04G was qualified as estimated due to the interference check exceeding control limits.
- Thallium was detected above the PRG of 10.5 µg/L at X633-04G at a concentration of 44.0BN µg/L.
- Gross alpha was detected above the background screening level of 43 pCi/L during both rounds of sampling at X633-04G at activities of 53 pCi/L and 68 pCi/L.

Analytical results and spatial distributions for metals are shown in Figure 4.6. Spatial distributions for nickel, silver and thallium are not consistent with expected patterns associated with contaminant releases. In addition, analytical values for these metals are only slightly greater than the screening levels (PRGs) selected for each constituent.

During both rounds of sampling, detections of chromium greater than the selected PRG were obtained at well, X633-07G.



Site Location Map



Legend

- Special studies sample location and data
- Monitoring Well included in other areas of concern

Cobalt 89.6 B, 83.5 B ug/L
(2nd Sampling Round / 1st Sampling Round)

ND	Not Detect
NA	Not Analyzed
PRG	Preliminary Remediation Goal
ug/L	Micrograms Per Liter
pCi/L	Picocuries Per Liter

Wells listing no data indicate no analytes detected above PRGs. See data tables for an explanation of data qualifiers.

Fig. 4.6

X-633 Area sampling locations with analyte concentrations exceeding preliminary remediation goals

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During the second round of sampling, an isolated detection of nickel greater than the selected PRG was obtained at well, X633-07G. The value for nickel only slightly exceeds the selected PRG.

During the second round of sampling, an isolated detection of silver slightly higher than the selected PRG was obtained at well, X633-04G.

During the first round of sampling, an isolated detection of thallium greater than the selected PRG was obtained at well, X633-04G. There is no apparent source for thallium connected to plant operational activities.

During both rounds of sampling, gross alpha was detected greater than the background screening level at well, X633-04G. Analytical values for gross alpha were within an order or magnitude of the background screening level.

4.6.2 Additional Groundwater Monitoring Program Low-flow Sampling Results

No additional low-flow sampling for metals or radiological parameters has occurred within this AOC.

4.6.3 Summary – X-633 Pump House and Cooling Towers Area

Chromium occurrences at the north X-633-2C cooling tower associated with X-633 Pump House appear to be a result of a past limited release. The isolated chromium detections are less than the acceptable noncancer risk (HI = 1) of 509 µg/L.

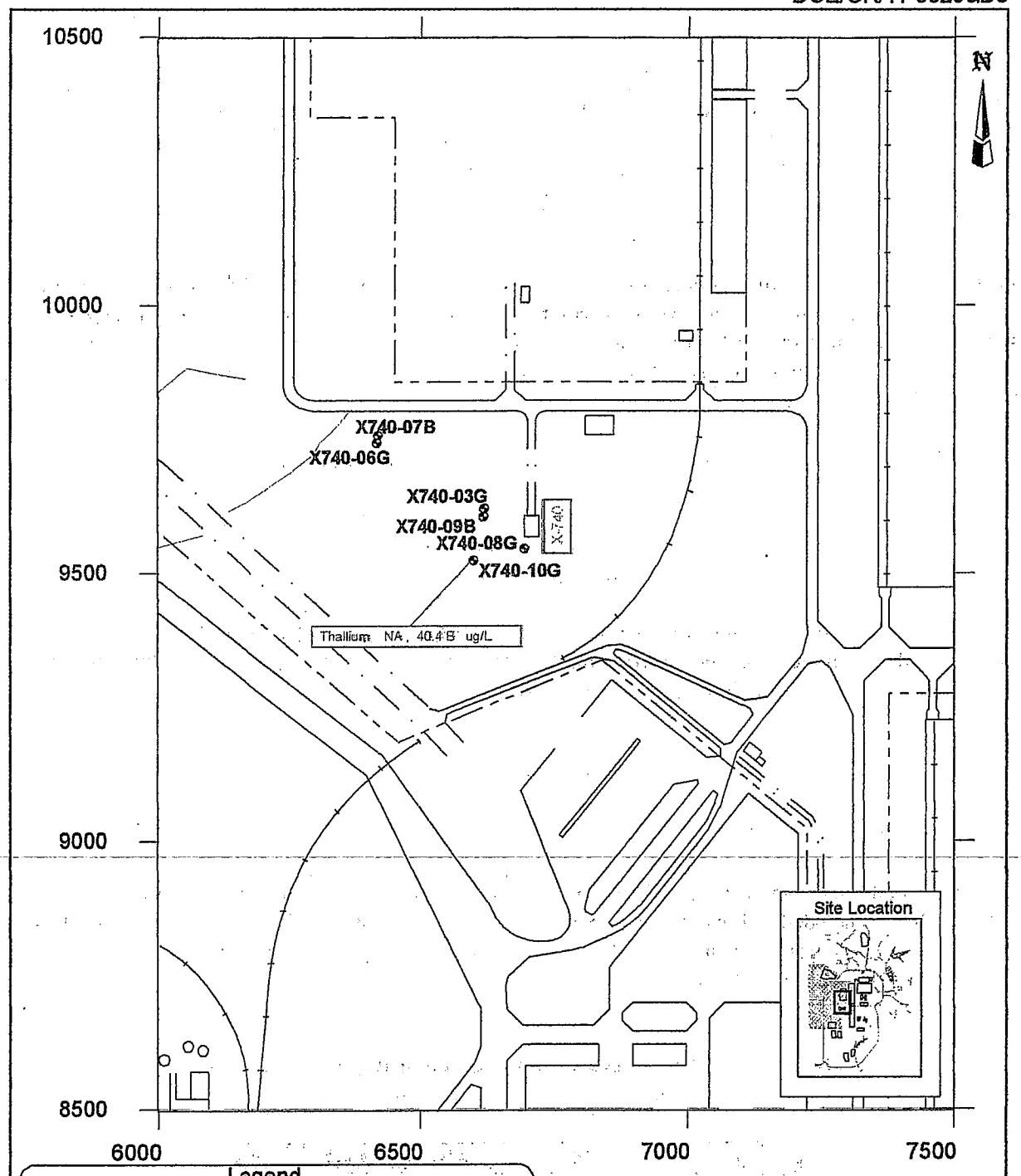
4.7 X-740 WASTE OIL HANDLING FACILITY AREA

4.7.1 Special Study Results

Four Gallia wells and two Berea wells were sampled at the X-740 Waste Oil Handling Facility. Analytical results for this AOC are included in Table A-7a (Gallia wells) and A-7b (Berea wells) in Appendix A. The number of occurrences for each analyte detected above MCLs, background values and PRGs is summarized in Table 4.7 below. Exceedances of PRGs from both rounds of sampling for both Gallia and Berea wells are shown on Figure 4.7.

Table 4.7. X-740 Waste Oil Handling Facility Area analytes detected above screening levels

Analyte	Number of Occurrences		
	>MCL	>Background	>PRG
Arsenic	0	1	0
Chromium	0	1	0
Silver	N/A	1	0
Thallium	1	1	1



Legend

⊕	Special studies sample location and data
ND	Not Detect
NA	Not Analyzed
PRG	Preliminary Remediation Goal
ug/L	Micrograms Per Liter
pCi/L	Picocuries Per Liter

Cobalt 89.6 B, 83.5 B ug/L
2nd Sampling Round
1st Sampling Round

Wells listing no data indicate no analytes detected above PRGs. See data tables for an explanation of data qualifiers.

Fig. 4.7

X-740 Area sampling locations with analyte concentrations exceeding preliminary remediation goals

DOCUMENT ID: 35T950 0202-10	DRAWING ID: x-740D3.CDR	DRAWING DATE: July 19, 2000 JP

- Thallium was the only constituent detected above PRGs in Gallia wells at this AOC.
- Thallium was detected above the PRG of 10.5 µg/L at X740-10G at a concentration of 40.4 B µg/L.
- No constituents were detected above PRGs in Berea wells at this AOC.

Analytical results and spatial distributions for metals are shown in Figure 4.7.

During the second round of sampling, an isolated detection of thallium greater than the selected PRG was obtained at well, X740-10G. The spatial distribution for thallium is not consistent with expected patterns associated with contaminant releases. In addition, the analytical value for this metal is only slightly greater than the screening level (PRG) selected for this constituent. There is no apparent source for thallium connected to plant operational activities.

4.7.2 Additional Groundwater Monitoring Program Low-flow Sampling Results

No additional low-flow sampling for metals or radiological parameters has occurred within this AOC.

4.7.3 Summary – X-740 Waste Oil Handling Facility Area

Data presented in Figure 4.7 indicates that only one well of the six sampled at this AOC had a detection of a metal (thallium) in the groundwater above the PRG. This single detection represents an isolated, random detection; therefore, there are no metals concerns for this AOC.

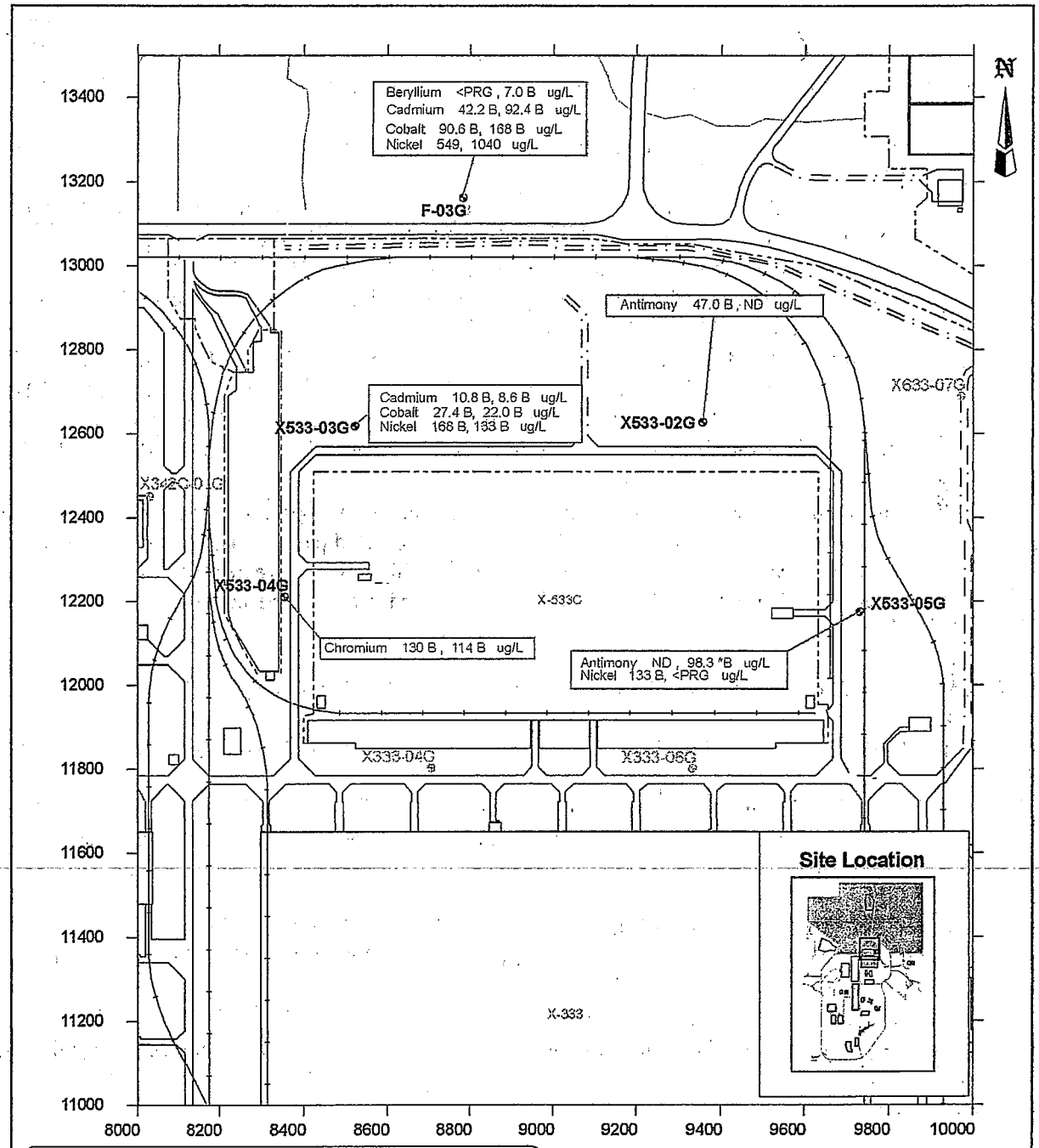
4.8 X-533 SWITCHYARD AND ASSOCIATED BUILDINGS AREA

4.8.1 Special Study Results

Five Gallia wells were sampled at the X-533 Switchyard and Associated Buildings Area. Analytical results for this AOC are included in Table A-8 in Appendix A. The number of occurrences for each analyte detected above MCLs, background values and PRGs is summarized in Table 4.8 below. Exceedances of PRGs/screening levels from both rounds of sampling for both Gallia and Berea wells are shown on Figure 4.8.

Table 4.8. X-533 Switchyard and Associated Building Area analytes detected above screening levels

Analyte	Number of Occurrences		
	>MCL	>Background	>PRG
Antimony	2	2	2
Beryllium	1	1	1
Cadmium	4	4	4
Chromium	2	3	2
Cobalt	N/A	4	4
Nickel	5	8	5
Silver	N/A	5	0



Legend

- Special studies sample location and data
- Monitoring Well included in other areas of concern

Cobalt 89.6 B, 83.5 B ug/L
- 2nd Sampling Round
- 1st Sampling Round

ND	Not Detected
NA	Not Analyzed
PRG	Preliminary Remediation Goal
ug/L	Micrograms Per Liter
pCi/L	Picocuries Per Liter

Wells listing no data indicate no analytes detected above PRGs. See data tables for an explanation of data qualifiers.

Fig. 4.8

X-533 Area sampling locations with analyte concentrations exceeding preliminary remediation goals

DOCUMENT ID: 35T950 0202-10	DRAWING ID: x-533D3.CDR	DRAWING DATE: July 19, 2000 JP

- Six metals (antimony, beryllium, cadmium, chromium, cobalt and nickel) were detected above PRGs at this AOC.
- Antimony was detected above the PRG of 36.5 µg/L at X533-02G and X533-05G at a concentration of 47.0 B µg/L and 98.3*B, respectively.
- Beryllium was detected above the PRG of 6.5 µg/L at F-03G at a concentration of 7.0 B µg/L.
- Cadmium was detected above the PRG of 6.5 µg/L during both rounds of sampling at F-03G and X533-03G at concentrations ranging from 8.6 B µg/L (X533-03G) to 92.4 B µg/L (F-03G).
- Chromium was detected above the PRG of 100 µg/L during both rounds of sampling at X533-04G at concentrations of 130 B µg/L and 114 B µg/L.
- Cobalt was detected above the PRG of 13 µg/L during both rounds of sampling at F-03G and X533-03G at concentrations ranging from 22.0 B µg/L (X533-03G) to 168 B µg/L (F-03G).
- Nickel was detected above the PRG of 100 µg/L at three wells; F-03G, X533-03G and X533-05G; at concentrations ranging from 133 B µg/L (X533-03G and X533-05G) to 1,040 µg/L (F-03G).

Analytical results and spatial distributions for metals are shown in Figure 4.8. Spatial distributions for antimony, beryllium, and chromium are not consistent with expected patterns associated with contaminant releases. In addition, analytical values for these metals are only slightly greater than the screening levels (PRGs) selected for each constituent. Cadmium, cobalt, and nickel were consistently detected in two adjacent wells.

Detections of antimony greater than the selected PRG were obtained in two wells, X533-02G and X533-05G.

An isolated detection of beryllium slightly greater than the selected PRG was obtained in well, F-03G.

During both rounds of sampling, detections of cadmium greater than the selected PRG were obtained at two wells, F-03G and X533-03G. In one of the five sampling locations, the concentration of cadmium was slightly more than an order of magnitude greater than the selected PRG during the second round of sampling.

During both rounds of sampling, detections of chromium greater than the selected PRG were obtained at well, X533-04G. Analytical values for chromium were only slightly greater than the selected PRG.

During both rounds of sampling, detections of cobalt greater than the selected PRG were obtained at two wells, F-03G and X533-03G. With the exception of F-03G (168B µg/L), cobalt detections are only slightly greater than the selected PRG; the selected PRG is based on a background value. No MCL or risk values exist for cobalt.

Detections of nickel greater than the selected PRG were obtained at two well locations, F-03G and X533-03G. A single detection of nickel during the first round of sampling was also detected at well X533-05G at a value slightly greater than the selected PRG.

4.8.2 Additional Groundwater Monitoring Program Low-flow Sampling Results

No additional low-flow sampling for metals or radiological parameters has occurred within this AOC.

4.8.3 Summary – X-533 Switchyard and Associated Buildings Area

The data indicates cadmium, cobalt and nickel were consistently detected in groundwater in an isolated area north of the X-533 Switchyard and Associated Buildings during both sampling rounds. These detections have enough spatial continuity that metals contamination could not be discounted, although a review of soil data in this area does not indicate significant concentrations of cadmium or cobalt. Nickel has been detected in soils throughout the area at concentrations slightly above background; the soil leaching value for nickel (8.2 mg/kg, Ohio EPA 1996) is less than the soil background value (34 mg/kg).

4.9 X-344/X-630 AREA

4.9.1 Special Study Results

Four Gallia wells were sampled at the X-344/X630 Area. Analytical results for this AOC are included in Table A-9 in Appendix A. The number of occurrences for each analyte detected above MCLs, background values and PRGs is summarized in Table 4.9 below. No constituents were detected above PRGs at this AOC; therefore, only sample locations from both rounds of sampling for both Gallia and Berea wells are shown on Figure 4.9.

Table 4.9. X-344/X-630 Area analytes detected above screening levels

Analyte	Number of Occurrences		
	>MCL	>Background	>PRG
Chromium	0	2	0
Nickel	0	1	0
Silver	N/A	4	0

- No metals or radionuclides were detected above either MCLs or PRGs at this AOC.
- Only three metals (chromium, nickel and silver) were detected above background levels.

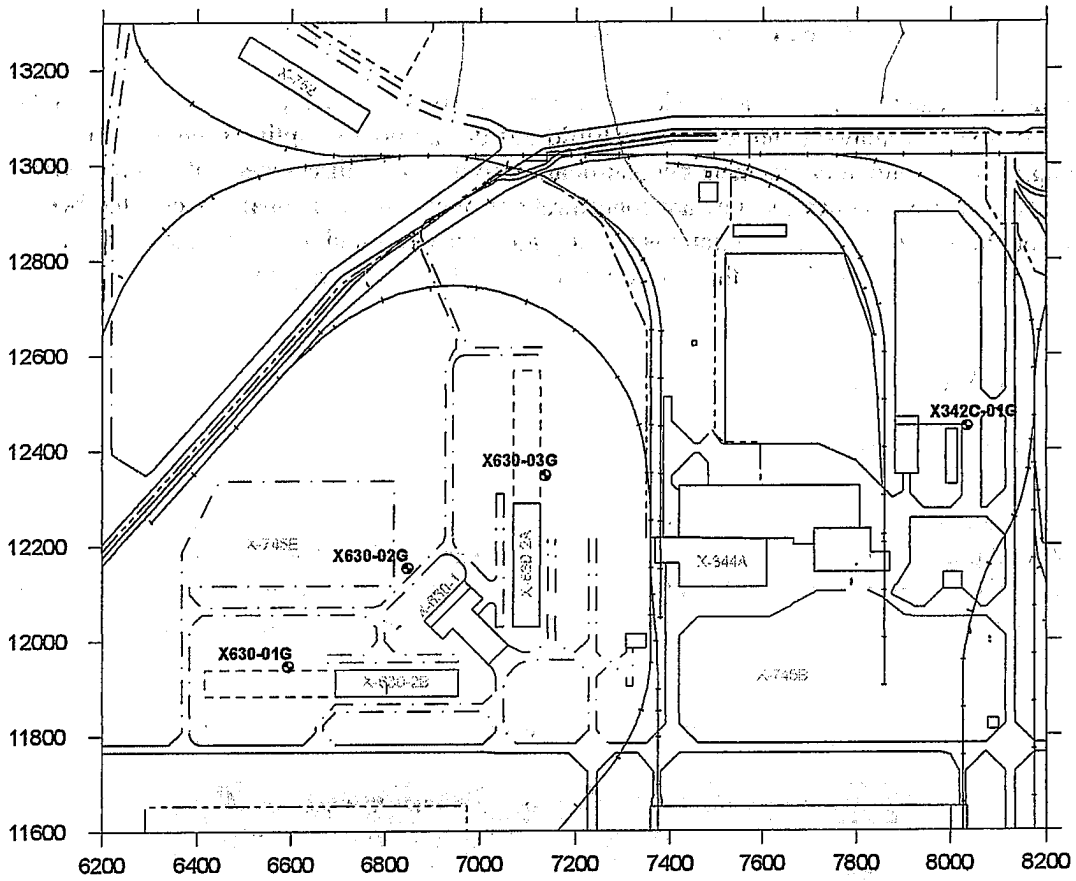
Data presented in Table 4.9 and Figure 4.9 show that there were no detections of constituents above PRGs in groundwater in this AOC.

4.9.2 Additional Groundwater Monitoring Program Low-flow Sampling Results

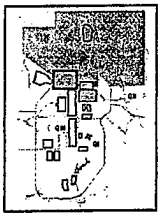
No additional low-flow sampling for metals or radiological parameters has occurred within this AOC.

4.9.3 Summary – X-344/X-630 Area

No metals or radiological parameters were detected above PRGs in this AOC; therefore, there are no metals concerns for this AOC.



Site Location



Legend

Special studies sample locations and data

Cobalt 89.6 B, 83.5 B ug/L

2nd Sampling Round
1st Sampling Round

ND	Non Detect
NA	Not Analyzed
PRG	Preliminary Remediation Goal
ug/L	Micrograms Per Liter
pCi/L	Picocuries Per Liter

Wells listing no data indicate no analytes detected above PRGs See data tables for an explaination of data qualifers

Fig. 4.9

X-344 / X-630 Area sampling locations with analyte concentrations exceeding preliminary remediation goals

DOCUMENT ID: 35T950 0202-10	DRAWING ID: x-344_630D3.CDR	DRAWING DATE: July 19, 2000 JP

4.10 X-734 LANDFILLS AREA

4.10.1 Special Study Results

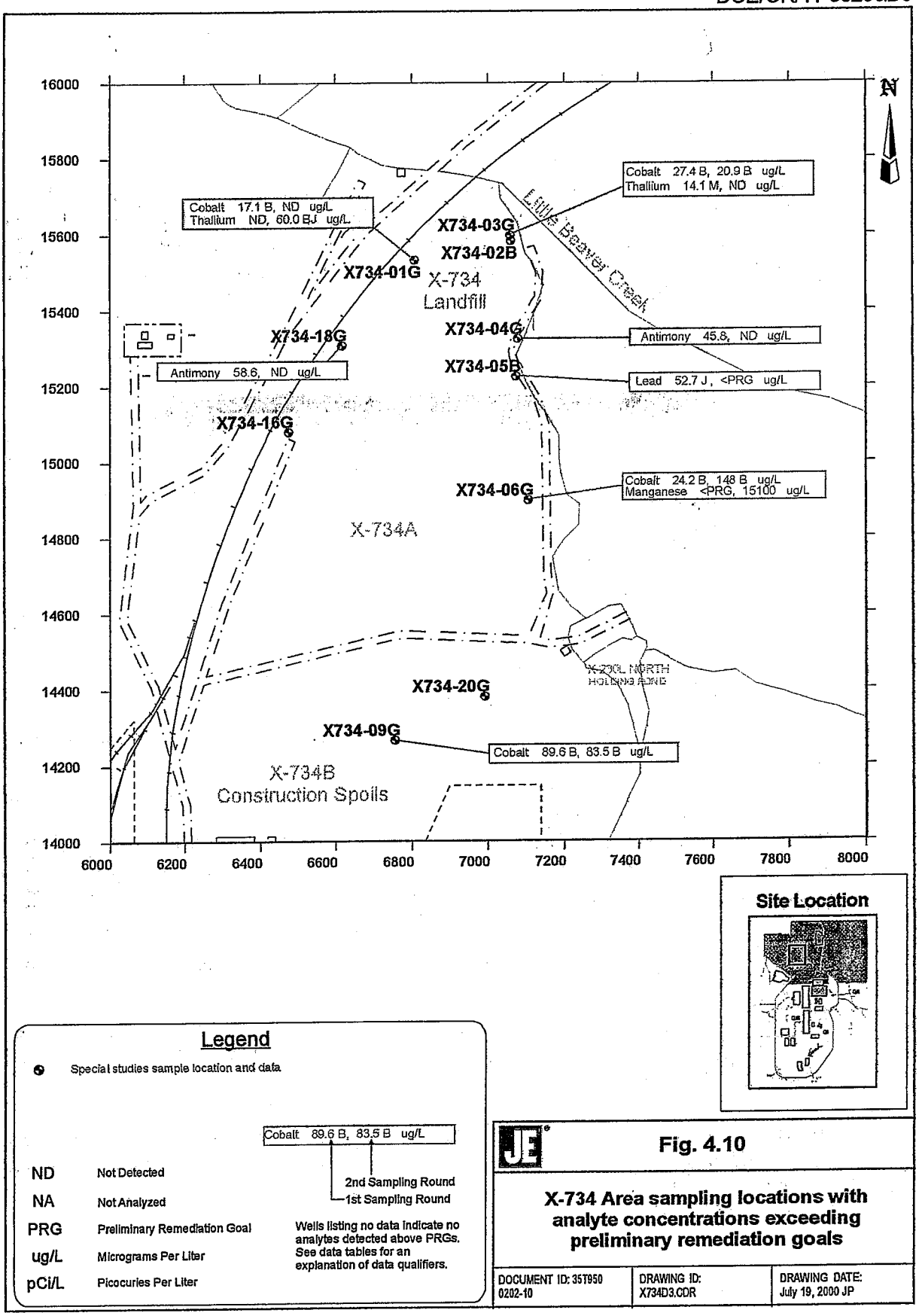
Eight Gallia wells and two Berea wells were sampled at the X-734 Landfills Area. Analytical results for this AOC are included in Table A-10a (Gallia wells) and Table A-10b (Berea wells) in Appendix A. The number of occurrences for each analyte detected above MCLs, background values and PRGs is summarized in Table 4.10 below. Exceedances of PRGs/screening levels from both rounds of sampling for both Gallia and Berea wells are shown on Figure 4.10.

Table 4.10. X-734 Landfills Area analytes detected above screening levels

Analyte	Number of Occurrences		
	>MCL	>Background	>PRG
Antimony	7	2	2
Arsenic	2	0	0
Barium	0	2	0
Cobalt	N/A	7	7
Lead	N/A	7	1
Manganese	N/A	N/A	1
Nickel	0	3	0
Silver	N/A	11	0
Thallium	2	2	2

- Four metals (antimony, cobalt, manganese, and thallium) were detected above PRGs in Gallia wells at this AOC.
- Antimony was detected above the PRG of 36.5 µg/L at X734-04G and X734-18G at concentrations of 45.8 µg/L and 58.6 µg/L, respectively.
- Cobalt was detected above the PRG of 13 µg/L at four wells; X734-01G, X734-03G, X734-06G and X734-09G; at concentrations ranging from 17.1 B µg/L (X734-01G) to 148 B µg/L (X734-06G). Cobalt was detected during both rounds of sampling at X734-03G, X734-06G and X734-09G.
- Lead was the only constituent detected above PRGs in Berea wells at this AOC. Lead was detected above the PRG of 50 µg/L at X734-05 B at a concentration of 52.7 J µg/L.
- Manganese was detected above the PRG of 14,300 µg/L at X734-06G at a concentration of 15,100 µg/L.
- Thallium was detected above the PRG of 10.5 µg/L at X734-01G and X734-03G at concentrations of 60.0 BJ µg/L and 14.1 M µg/L, respectively. The result for thallium at X734-01G was qualified as estimated due to the calibration verification not meeting acceptance limits.

Analytical results and spatial distributions for metals are shown in Figure 4.10. Spatial distributions for antimony, lead, and thallium are not consistent with expected patterns associated with contaminant releases. In addition, analytical values for these metals are only slightly greater than the screening levels (PRGs) selected for each constituent.



Site Location

Legend

- Special studies sample location and data

Cobalt 89.6 B, 83.5 B ug/L
- 2nd Sampling Round
- 1st Sampling Round

ND	Not Detected
NA	Not Analyzed
PRG	Preliminary Remediation Goal
ug/L	Micrograms Per Liter
pCi/L	Picocuries Per Liter

Wells listing no data indicate no analytes detected above PRGs. See data tables for an explanation of data qualifiers.

Fig. 4.10

X-734 Area sampling locations with analyte concentrations exceeding preliminary remediation goals

DOCUMENT ID: 35T950 0202-10	DRAWING ID: X734D3.CDR	DRAWING DATE: July 19, 2000 JP

During the first round of sampling, detections of antimony greater than the selected PRG were obtained in two wells, X734-04G and X734-18G. Both antimony detections are only slightly greater than the selected PRG. There were no detections of antimony during the second round of sampling.

During both rounds of sampling, detections of cobalt greater than the selected PRG were obtained at three well locations, X734-03G, X734-06G and X734-09G. A single detection of cobalt during the first round of sampling was also detected at well X734-01G at a value slightly greater than the selected PRG.

During the first round of sampling, a detection of lead slightly greater than the selected PRG was obtained at X734-05B. During the second round of sampling, all lead values were either below the selected PRG or non-detect.

During the second round of sampling, a detection of manganese greater than the selected PRG was obtained in well, X734-06G. The value is only slightly greater than the selected PRG.

Thallium was detected slightly greater than the selected PRG during the first round of sampling at well X734-03G and during the second round of sampling at well X734-01G. There is no apparent source for thallium connected to plant operational activities.

4.10.2 Additional Groundwater Monitoring Program Low-flow Sampling Results

No additional low-flow sampling for metals or radiological parameters has occurred within this AOC.

4.10.3 Summary – X-734 Landfills Area

The data indicates isolated detections of metals in groundwater at the X-734 Landfills. Antimony, cobalt, and thallium were detected above PRGs, at approximately the same concentrations, in both upgradient (west) and downgradient (east) wells; therefore, it is unlikely that these metals have their origins in waste deposited within the landfill.

Cobalt was the only metal detected at levels greater than the PRG during both rounds of sampling in three wells, X734-03G, X734-06G, and X734-09G. These results were collected from wells located adjacent to the landfills, so a release cannot be ruled out. However, two wells, X734-03G and X734-06G are screened within the North Drainage Ditch alluvium composed of sediment and reworked Sunbury and Berea deposits. Background levels for sediment and alluvium have not been developed, and the background UTL for cobalt in Berea groundwater is seven times higher than the Gallia. A release of inorganic constituents from the landfill is not likely because no other metals consistently exceeded PRGs in these wells nor within this AOC.

Routine groundwater monitoring at the X-734 Landfills to be initiated following cap construction will include cobalt and should be sufficient to evaluate any contaminant release from the landfill. Monitoring requirements for the X-734 Landfills will be included in future revisions of the IGWMP. Other metal concentrations, radiological activities and associated distribution patterns do not indicate metals or radiological contamination problems within this AOC.

5. CONCLUSIONS

The objective of this metals study is to confirm or refute earlier determinations regarding contamination by determining if the elevated concentrations observed during the RFIs were due to sample turbidity. This determination involved a comparison of turbidity values and associated metals concentrations obtained from the RFI samples collected with a bailer to those obtained using the low-flow sampling technique.

Selection of the ten metal AOCs was based on metals results from unfiltered groundwater sampled with bailers during the RFIs. Each AOC had one or more of the following criteria: historically high metal concentrations in one or more wells; high frequency of wells with unfiltered metal detections above background levels or MCLs; a potential source such as a landfill, or a known groundwater VOC plume. Fifty-seven representative wells were selected based on historical metals results and/or to encompass potential source areas. If extensive metals contamination is not in the majority of these AOCs where contamination is most likely to occur, then it could be inferred that metal contamination is not present in wells outside of the selected AOCs.

Two rounds of low-flow sampling were completed at each AOC from August 1997 through March 1999. Additional low-flow sampling results from wells within each AOC collected during 1998 through first quarter 1999, as part of the PORTS groundwater monitoring program, were also evaluated.

5.1 TURBIDITY

In comparing the turbidity results obtained during the RFI versus those obtained from low-flow sampling events, the first round of low-flow sampling showed a reduction in 94.3% of the wells and the second round showed a reduction in 96.5% of the wells. A reduction in constituent concentrations occurred in 82% of wells which had analyses performed in both sample sets; this also resulted in fewer PRG exceedances. Therefore, it can be concluded that turbidity and associated metals concentrations are reduced through low-flow sampling.

5.2 METALS

Three AOCs have no metal concerns and require no further monitoring for non-radiological metals. These three AOCS are:

- Quadrant II Groundwater Investigative Area
- X-740 Waste Oil Handling Facility Area (Quadrant III)
- X-344/X-630 Area (Quadrant IV)

Additional monitoring for metals is required at seven of the ten AOCs:

- Quadrant I Groundwater Investigative Area
- X-120/X-749/Peter Kiewit Landfill Area (Quadrant I)
- X-701B Holding Pond Area (Quadrant II)

- X-744G Bulk Storage Building (Quadrant II)
- X-633 Pump House and Cooling Towers Area (Quadrant II)
- X-533 Switchyard and Associated Buildings (Quadrant IV)
- X-734 Landfills Area (Quadrant IV)

If the groundwater monitoring should demonstrate an increase of metals at these seven units, then additional remedial evaluation will be performed.

Monitoring associated with the Peter Kiewit Landfill (part of the X-120/X-749/PK AOC) and the X-734 Landfills Area includes metals analyses. Cobalt was detected during two rounds of sampling from wells screened within the drainage ditch alluvium composed of sediment and reworked Sunbury and Berea deposits. Naturally occurring cobalt has been identified in the Berea formation, based on background sampling results. These results were collected from wells located adjacent to the landfills, so a release cannot be ruled out. Other metal concentrations, radiological activities and associated distribution patterns do not indicate metals or radiological contamination problems within these AOCs. Monitoring, including analysis for cobalt, will continue as prescribed in the IGWMP for these landfills.

Injection of oxidants associated with demonstration projects to evaluate technologies applicable in the remediation of VOCs, resulted in residual oxidant concentrations (containing manganese) that should be monitored at the X-701B and Quadrant I Groundwater Investigative Areas. Data gathered from this monitoring will be useful in understanding dissipation rates for oxidants in the event of future injection applications.

One AOC, X-701B Holding Pond Area in (Quadrant II), has two wells, X701-BW2G and X701-09G with an array of metals above PRGs located centrally within the VOC plume. These wells are separated by wells with lower metals concentrations (from non-detect to less than PRGs). This discontinuity in metals concentrations indicates that there is not a widespread metals problem in this AOC. However, additional monitoring for selected metals is warranted.

The three remaining AOCs evaluated during this special study have detections of metals above PRGs that were detected in two or more adjacent wells during both sampling rounds or during both rounds of sampling in one well in the vicinity of a plausible source. These three AOCs and associated potential contaminants include:

Area of Concern	Potential Contaminants
X-744G Bulk Storage Building	Cadmium, Nickel
X-533 Switchyard and Associated Buildings	Cadmium, Cobalt, Nickel
X-633 Pump House and Cooling Tower Area	Chromium

5.2.1 X-744G Bulk Storage Building

Cadmium and nickel were detected above PRGs during both rounds of sampling in three wells south and west of the X-744G Bulk Storage Building (Quadrant II). These wells are bounded by wells where cadmium and nickel concentrations were either below detection limits or below background levels. Nickel concentrations in this area do not result in HI values greater than one; however, cadmium HI values are

greater than one. A review of soil data in this area did not indicate contaminant sources for these two metals. It should also be noted that the low-flow sampling conducted during this study produced turbid samples at most of the wells in this area. Continued monitoring of this area during the Quadrant II CMI is warranted.

5.2.2 X-533 Switchyard and Associated Buildings

Cadmium, cobalt and nickel were detected above PRGs in groundwater in the vicinity of the X-533 Switchyard and Associated Buildings (Quadrant IV). Cadmium, cobalt and nickel were detected during both rounds of sampling at X533-03G and F-03G north of the X-533 Switchyard and north of the transformer cleaning pad, respectively. A review of soil data in this area does not indicate significant concentrations of cadmium or cobalt, although nickel is detected slightly above background throughout the area. Although widespread occurrence of these metals in groundwater at this AOC is not apparent, continued monitoring may be warranted.

5.2.3 X-633 Pump House and Cooling Tower Area

Chromium was detected above the PRG in groundwater in the vicinity of the X-633 Pump House and Cooling Towers (Quadrant II). Chromium was detected during both rounds of sampling at X633-07G west of the X-633-2C cooling tower basin. A review of soil data in this area does not indicate significant concentrations of chromium in the area. Although widespread occurrence of chromium in groundwater at this AOC is not apparent, continued monitoring may be warranted.

5.3 RADIOLOGICAL PARAMETERS

The Quadrant II Groundwater Investigative Area and the X-701B Holding Pond were the only AOCs with technetium activities that exceeded the PRG. These areas are controlled by groundwater extraction systems and are being remediated concurrently with the VOC plumes. Treatment facility effluent monitoring indicates that any radiological constituents contained in influent are being removed.

An evaluation of wells with repeated detections of gross alpha or gross beta greater than background indicates correspondingly elevated levels of uranium or technetium, respectively. Turbidity appears to have been responsible for most of the elevated gross alpha and gross beta activities detected in RFI samples.

6. REFERENCES

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Ohio EPA. 1996. Ohio EPA Derived Leached Based Soil Values Technical Guidance Document. Columbus, Ohio.

APPENDIX A – ANAYLTICAL RESULTS SUMMARY – Metals and Radiological Parameter Special Study Sampling

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Table A-1 Quadrant I Groundwater Investigative Area

Metals and Radiological Parameter Special Study Sampling
Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

Well Number					X231A-04G		X231B-02G		X231B-03G		X231B-04G	
Date Sampled					03-Oct-97	31-Aug-98	25-Sep-97	11-Aug-98	24-Sep-97	11-Aug-98	25-Sep-97	13-Aug-98
	Units	MCL	Background	PRG								
Turbidity	NTU				55	53	10	22	55	56	163	127
Antimony	ug/L	6	36.5	36.5	NA	40.8 U	NA	NA	NA	NA	NA	NA
Arsenic	ug/L	50	92	92	3.3 U	29.4 U	3.3 U	29.4 U	3.3 U	35.4 B	5.8	29.4 U
Barium	ug/L	2000	151	2000	NA	55.1 B	NA	55.7 B	NA	50.9 B	NA	58.6 JB
Beryllium	ug/L	4	6.5	6.5	1.1 U	0.49 B	1.1 U	0.80 B	1.1 U	0.76 B	1.1 U	0.20 U
Cadmium	ug/L	5	6.5	6.5	4.3 B	2.3 U	1.8 U	2.3 U	1.8 U	2.3 U	1.8 U	2.3 U
Chromium	ug/L	100	21	100	13.5 B	12.3 U	3 U	12.3 U	3 U	12.3 U	18.7 B	12.3 U
Cobalt	ug/L		13	13	3.9 B	19.8 U	**21.6 B**	**20.7 B**	3.4 U	19.8 U	**24.9 B**	19.8 U
Lead	ug/L		16	50	3.3 UN	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
Manganese	ug/L			14300	58.3 B	143 B	608	566 J	93.6 B	133 B*J	971	679
Mercury	ug/L	2	1.5	2	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	ug/L	100	30.5	100	**66.6 B**	**36.3 B**	13.5 BJ	13.9 B	8.3 BJ	15.8 B	21.7 BJ	29.5 B
Silver	ug/L		10.5	509	NA	9.8 B	NA	4.1 U	NA	4.1 U	NA	4.1 U
Thallium	ug/L	2	10.5	10.5	NA	39.1 U	NA	39.1 U	NA	39.1 U	NA	39.1 UJ
Vanadium	ug/L		41	713	2.5 U	3.3 B	2.5 U	2.9 B	3.7 B	3.0 B	14.8 B	9.9 B
Gross Alpha	pCi/L		43		NA	9	NA	6 U	NA	5 U	NA	20
Gross Beta	pCi/L		88		NA	15 U	NA	14 U	NA	14 U	NA	42
Technetium	pCi/L			3790	NA	21 U	NA	21 U	NA	21 U	NA	48
Uranium	ug/L		1000	1000	1 U	1 U	1 U	1 U	1 U	1 U	2.4	4.02

Shading indicates result above MCL.

Bolded number indicates result above Background.

Bold border indicates result above PRG

* = Duplicate analysis not within control limits.

B = Result less than Practical Quantification Limit and greater than or equal to Instrument Detection Limit.

J = Qualify data for the sample as estimated.

M = Duplicate injection precision not met.

N = Sample spike recovery not within control limits.

U = Analyte analyzed for but not detected. Analyte was below the Instrument Detection Limit.

NA = Not analyzed

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Table A-1 Quadrant I Groundwater Investigative Area

Metals and Radiological Parameter Special Study Sampling
Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

Well Number					X231B-05G		X231B-06G		X231B-10G		X231B-11G	
Date Sampled					25-Sep-97	12-Aug-98	26-Sep-97	12-Aug-98	29-Sep-97	17-Aug-98	30-Sep-97	17-Aug-98
	Units	MCL	Background	PRG								
Turbidity	NTU				885	40	7	12	26	70	5	2
Antimony	ug/L	6	36.5	36.5	NA	NA	NA	NA	NA	40.8 U	NA	40.8 U
Arsenic	ug/L	50	92	92	8.7	29.4 U	3.3 U	29.4 U	3.3 U	29.4 U	3.3 U	29.4 U
Barium	ug/L	2000	151	2000	NA	30.9 B	NA	42.7 B	NA	37.5 B	NA	11.4 B
Beryllium	ug/L	4	6.5	6.5	1.1 U	0.58 B	1.1 U	0.43 B	1.1 U	0.20 U	1.1 U	0.20 U
Cadmium	ug/L	5	6.5	6.5	1.8 U	2.3 U	1.8 U	2.3 U	1.8 U	2.3 U	1.8 U	2.3 U
Chromium	ug/L	100	21	100	15 B	12.3 U	3.6 B	12.3 U	3 U	12.3 U	4 B	12.3 U
Cobalt	ug/L		13	13	**24.7 B**	19.8 U	3.4 U	19.8 U	3.4 U	19.8 U	6.8 B	19.8 U
Lead	ug/L		16	50	4.4 M	3.3 U	3.3 UJ	3.3 U	3.3 UN	3.3 U	3.3 UN	3.3 U
Manganese	ug/L			14300	662	289 J*	296	757 J*	24.6 B	35.4 B	532	565
Mercury	ug/L	2	1.5	2	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	ug/L	100	30.5	100	16.3 BJ	7.2 B	8.9 B	10.2 B	7.4 B	**30.9 B**	21.2 B	**44.5 B**
Silver	ug/L		10.5	509	NA	5.2 B	NA	8.2 B	NA	4.1 U	NA	**23.2 B**
Thallium	ug/L	2	10.5	10.5	NA	39.1 U	NA	39.1 U	NA	39.1 U	NA	39.1 U
Vanadium	ug/L		41	713	**41.5 B**	2.7 B	2.5 U	2.6 U	2.5 U	5.2 B	2.5 U	3.6 B
Gross Alpha	pCi/L		43		NA	7 U	NA	7 U	NA	5 U	NA	18 U
Gross Beta	pCi/L		88		NA	15 U	NA	71	NA	23	NA	30 U
Technetium	pCi/L			3790	NA	21 U	NA	50	NA	21 U	NA	21 U
Uranium	ug/L		1000	1000	2.9	1.08	1 U	1.43	1 U	1 U	1 U	1 U

Shading indicates result above MCL
Bolded number indicates result above Background.
Bold border indicates result above PRG
* = Duplicate analysis not within control limits.
B = Result less than Practical Quantification Limit and greater than or equal to Instrument Detection Limit.
J = Qualify data for the sample as estimated.
M = Duplicate injection precision not met.
N = Sample spike recovery not within control limits.
U = Analyte analyzed for but not detected. Analyte was below the Instrument Detection Limit.
NA = Not analyzed

Table A-1 Quadrant I Groundwater Investigative Area

Metals and Radiological Parameter Special Study Sampling
Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

Well Number					X231B-12G		X231B-19G		X231B-36G		X231B-37G	
Date Sampled					30-Sep-97	18-Aug-98	27-Sep-97	01-Sep-98	27-Sep-97	31-Aug-98	29-Sep-97	18-Aug-98
	Units	MCL	Background	PRG								
Turbidity	NTU				1	1	21	3	29	75	4	10
Antimony	ug/L	6	36.5	36.5	NA	NA	NA	40.8 U	NA	40.8 U	NA	NA
Arsenic	ug/L	50	92	92	3.3 U	29.4 U	3.3 U	29.4 U	3.3 U	29.4 U	3.3 U	29.4 U
Barium	ug/L	2000	151	2000	NA	11.3 B	NA	4.3 B	NA	6.4 B	NA	21.4 B
Beryllium	ug/L	4	6.5	6.5	1.1 U	0.20 U	1.1 U	0.20 U	1.1 U	0.40 B	1.1 U	0.20 U
Cadmium	ug/L	5	6.5	6.5	1.8 U	2.3 U	1.8 U	2.3 U	1.8 U	2.3 U	1.8 U	2.3 U
Chromium	ug/L	100	21	100	3 U	12.3 U	4.4 B	12.3 U	6.1 B	12.3 U	3 U	12.3 U
Cobalt	ug/L		13	13	3.4 U	19.8 U	3.4 U	**19.8 B**	3.4 U	19.8 U	**73.8 B**	**64.1 B**
Lead	ug/L		16	50	3.3 UN	3.3 U	3.3 UNJ	3.3 UN	3.3 UNJ	3.3 NU	3.3 UN	3.3 U
Manganese	ug/L			14300	27.9 B	25.5 B	78.5 B	35.0 B	242 B	190 B	4470	4350
Mercury	ug/L	2	1.5	2	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	ug/L	100	30.5	100	6.5 U	7.0 U	6.5 U	11.4 B	6.5 U	7.0 U	18.8 B	26.2 B
Silver	ug/L		10.5	509	NA	4.1 B	NA	4.1 U	NA	**17.6 B**	NA	5.2 B
Thallium	ug/L	2	10.5	10.5	NA	39.1 U	NA	39.1 U	NA	61.5 B	NA	122 B
Vanadium	ug/L		41	713	2.5 U	2.6 U	4.5 B	2.6 U	3.1 B	4.2 B	7.4 B	2.8 B
Gross Alpha	pCi/L		43		NA	8 U	NA	9 U	NA	18 U	NA	6 U
Gross Beta	pCi/L		88		NA	15 U	NA	15 U	NA	37	NA	14 U
Technetium	pCi/L			3790	NA	21 U	NA	21 U	NA	21 U	NA	21 U
Uranium	ug/L		1000	1000	1 U	1 U	1 U	1 U	1 U	1.02	1 U	1 U

Shading indicates result above MCL

Bolded number indicates result above Background.

Bold border indicates result above PRG

* = Duplicate analysis not within control limits.

B = Result less than Practical Quantification Limit and greater than or equal to Instrument Detection Limit.

J = Qualify data for the sample as estimated.

M = Duplicate injection precision not met.

N = Sample spike recovery not within control limits.

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NA = Not analyzed

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Table A-1 Quadrant I Groundwater Investigative Area

Metals and Radiological Parameter Special Study Sampling
Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

Well Number					X626-01G		X626-07G		X710-03G		X747F-01G	
Date Sampled					29-Sep-97	31-Aug-98	30-Sep-97	31-Aug-98	27-Sep-97	31-Aug-98	20-Aug-98	19-Mar-99
	Units	MCL	Background	PRG								
Turbidity	NTU				9	1	65	91	5	1	1	1
Antimony	ug/L	6	36.5	36.5	NA	40.8 U	NA	40.8 U	NA	40.8 U	40.8 U	40.8 U
Arsenic	ug/L	50	92	92	3.3 U	29.4 U	3.3 U	29.4 U	3.3 U	29.4 U	29.4 U	29.4 U
Barium	ug/L	2000	151	2000	NA	8.8 B	NA	12.4 B	NA	3.9 B	34.9 B	37.8 B
Beryllium	ug/L	4	6.5	6.5	1.1 U	0.41 B	1.1 U	0.62 B	1.1 U	0.49 B	0.20 U	0.20 U
Cadmium	ug/L	5	6.5	6.5	1.8 U	2.3 U	1.8 U	2.3 U	6.8 B	3.9 B	2.3 U	2.3 U
Chromium	ug/L	100	21	100	7.2 B	12.3 U	4.1 B	12.3 U	3 U	12.3 U	12.3 U	12.3 U
Cobalt	ug/L		13	13	3.4 U	19.8 U	3.4 U	19.8 U	5.5 B	19.8 U	19.8 U	19.8 U
Lead	ug/L		16	50	3.3 UN	3.3 U	3.3 UN	3.3 U	3.3 UNJ	3.3 UN	3.3 UN	3.3 U
Manganese	ug/L			14300	26.8 B	35.3 B	37.5 B	32.8 B	1150	969	0.93 B	2.5 B
Mercury	ug/L	2	1.5	2	NA	NA	NA	NA	NA	NA	NA	2 U
Nickel	ug/L	100	30.5	100	6.5 U	7.0 U	6.5 U	8.3 B	27.1 B	**50.7 B**	8.0 B	8.7 *BJ
Silver	ug/L		10.5	509	**10.9 B**	4.1 U	**14.0 B**	4.1 U	NA	**25.5 B**	5.5 B	4.1 U
Thallium	ug/L	2	10.5	10.5	NA	39.1 UN	NA	39.1 UN	NA	39.1 UN	39.1 U	39.1 UJ
Vanadium	ug/L		41	713	2.5 U	2.6 U	4.3 B	8.4 B	2.5 U	5.4 B	2.6 U	2.6 U
Gross Alpha	pCi/L		43		NA	8 U	NA	7 U	NA	18 U	6 U	6 U
Gross Beta	pCi/L		88		NA	17	NA	21	NA	31 U	14 U	16
Technetium	pCi/L			3790	NA	23	NA	21 U	NA	21 U	27 U	21 U
Uranium	ug/L		1000	1000	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

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Table A-1 Quadrant I Groundwater Investigative Area

Metals and Radiological Parameter Special Study Sampling

Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

Well Number					X747F-02G		X747F-03G		X749A-10G		X749A-11G	
Date Sampled					20-Aug-98	19-Mar-99	20-Aug-98	19-Mar-99	29-Sep-97	31-Aug-98	30-Sep-97	01-Sep-98
	Units	MCL	Background	PRG								
Turbidity	NTU				1	1	4	1	167	317	55	13
Antimony	ug/L	6	36.5	36.5	40.8 U	40.8 U	40.8 U	40.8 U	NA	40.8 U	NA	40.8 U
Arsenic	ug/L	50	92	92	29.4 U	29.4 U	29.4 U	29.4 U	12	29.4 U	3.3 U	29.4 U
Barium	ug/L	2000	151	2000	5.9 B	9.7 B	12.7 B	15.1 B	NA	46.5 B	NA	99.4 B
Beryllium	ug/L	4	6.5	6.5	0.20 U	0.28 B	0.20 U	0.28 B	1.1 U	0.47 B	1.1 U	0.20 U
Cadmium	ug/L	5	6.5	6.5	2.3 U	2.3 U	2.3 U	2.6 B	1.8 U	2.3 U	1.8 U	2.3 U
Chromium	ug/L	100	21	100	**54.7 B**	12.3 U	**31.8 B**	**35.8 B**	7.3 B	12.3 U	**40 B**	**23.2 B**
Cobalt	ug/L		13	13	19.8 U	19.8 U	19.8 U	19.8 U	3.5 B	19.8 U	5.8 B	19.8 U
Lead	ug/L		16	50	3.3 UN	3.3 U	3.3 UN	3.3 U	3.3 UN	3.3 UN	3.3 UN	3.3 U
Manganese	ug/L			14300	13.2 B	895	41.6 B	60.8 B	66.6 B	155 B	27.7 B	25.6 B
Mercury	ug/L	2	1.5	2	NA	2 U	NA	2 U	NA	NA	NA	NA
Nickel	ug/L	100	30.5	100	15.0 B	19.2 *BJ	20.7 B	9.6 BJ	6.5 U	18.2 B	6.5 U	15.2 B
Silver	ug/L		10.5	509	**23.1 B**	**24.9 B**	**14.7 B**	**15.0 B**	NA	4.1 U	NA	9.6 B
Thallium	ug/L	2	10.5	10.5	39.1 U	39.1 UJ	39.1 U	39.1 UJ	NA	39.1 U	NA	39.1 U
Vanadium	ug/L		41	713	2.6 U	4.4 B	2.6 U	3.9 B	5.2 B	11.4 B	2.5 U	2.6 U
Gross Alpha	pCi/L		43		10 U	10 U	8 U	8 U	NA	11	NA	6 U
Gross Beta	pCi/L		88		16 U	15 U	15 U	24	NA	15 U	NA	15 U
Technetium	pCi/L			3790	28 U	21 U	27 U	21 U	NA	21 U	NA	21 U
Uranium	ug/L		1000	1000	1 U	1 U	1 U	1.30	1.4	1.04	6.6	5.42

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